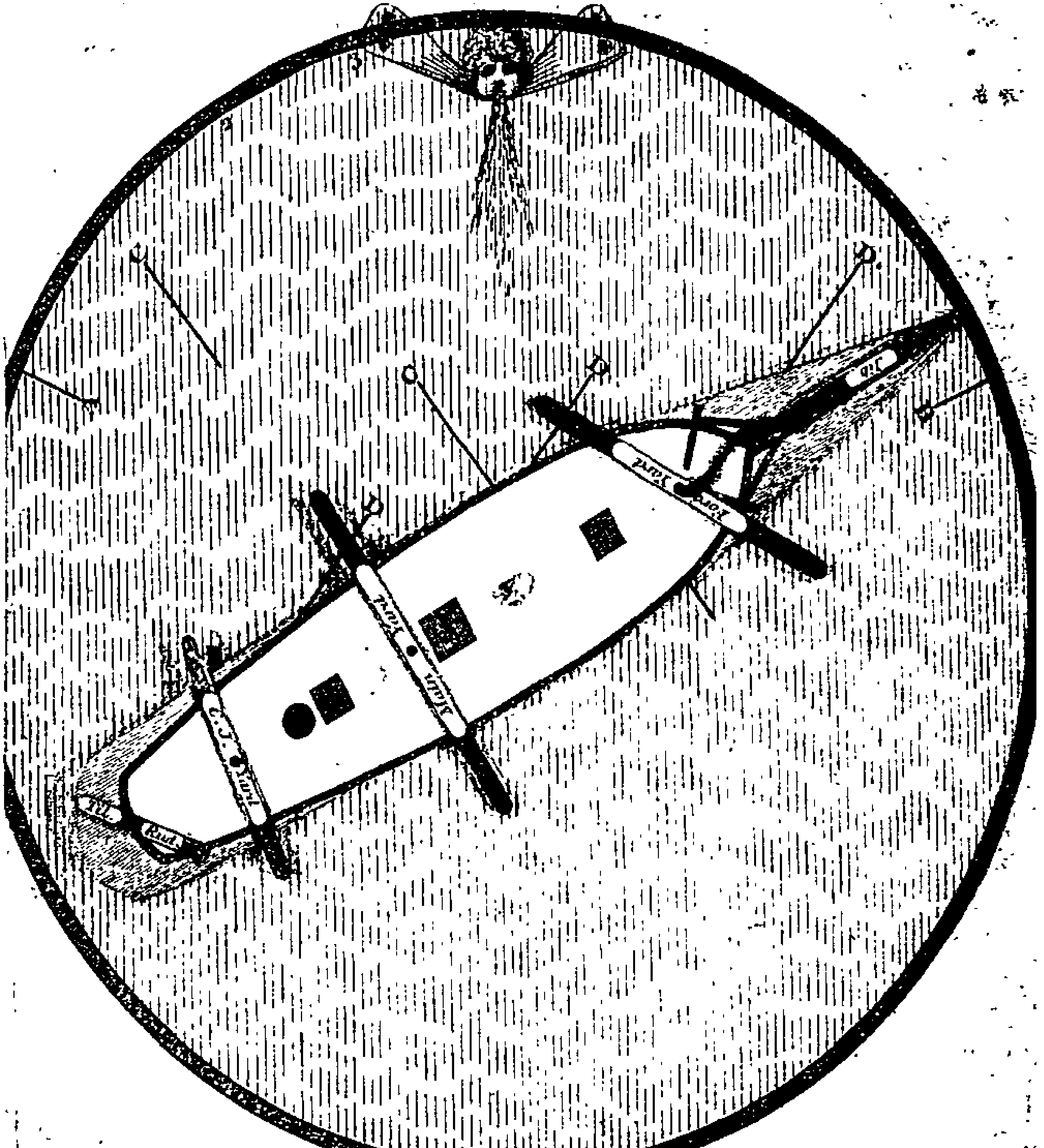

Published as the Act directs Aug.st 25 1793

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A

TREATISE

ON THE

THEORY AND PRACTICE

OF

SEAMANSHIP:

CONTAINING

GENERAL RULES FOR MANŒUVRING VESSELS,

WITH

A MOVEABLE FIGURE OF A SHIP,

So planned that the Sails, Rudder, and Hull may be made to perform the Manœuvres according to the Rule laid down.

TO THE ABOVE IS ADDED

A Miſcellaneous Chapter on the various Contrivances againſt Accidents,

AND A

SYSTEM OF NAVAL SIGNALS,

THE WHOLE FORMING

A uſeful Compendium to the OFFICER, to Inſtruct him when *Young*, and to Remind him when *Old*.

THE SECOND EDITION, CORRECTED AND ENLARGED.

BY

RICHARD HALL GOWER,

IN THE SERVICE OF THE HONOURABLE EAST INDIA COMPANY.

LONDON:

Printed for G. G. and J. ROBINSON, Paternoſter Row.

1796.

TO THE

HONOURABLE

THE

COURT OF DIRECTORS

OF THE

UNITED COMPANY OF MERCHANTS OF ENGLAND,

TRADING TO THE EAST INDIES,

THIS WORK,

(BY THEIR PERMISSION,)

IS HUMBLY DEDICATED,

BY THEIR VERY OBEDIENT,

AND FAITHFUL SERVANT,

R. H. GOWER.

ADVERTISEMENT

TO THE

SECOND EDITION.

IN justice to the Author, it becomes necessary for him to state, that during his late voyage to India, Mr. *Steel*, a bookseller, of Union-row, Little Tower-hill, republished nearly the whole of the 2d, 3d, 4th, 5th, 6th, 7th, and 8th chapters of the first edition of this work, in a voluminous compilation termed, "Elements and Practice of Rigging and Seamanship." However illiberal such treatment must appear to the truly generous mind, the Author would the more freely forgive

Mr. *Steel*, had he not, by artfully endeavouring to evade the piracy, been guilty of ſuch miſrepreſentation, as has a tendency to bring his profeſſional knowledge in queſtion. Several deviations of this ſort are contained in the 2d volume, 4to, of Mr. *Steel's* work, and are produced to ſhew that the Author has juſt reaſon for complaining.

1ſt, In page 282 of Mr. *Steel's* work, the figure at the front of This treatiſe (which is original) is deviated from, by the introduction of a uſeleſs moveable circle.

2d, In page 284 of Mr. *Steel's* work is a problem from the firſt edition of this Treatiſe "Upon the Stability of Veſſels." In this problem Mr. *Steel* has introduced a fourth point, by the name of *metacenter*, which, one might ſuppoſe, was introduced for the purpoſe of bewildering the reader; however, after reading it ſeveral times over, it may poſſibly be concluded that the *metacenter* and *centre of motion* are the ſame thing; particularly if the reader omits the forced concluſion of the third para-

paragraph; and, indeed, if Mr. *Steel* will grant, that *whatever part of a lever touches the fulcrum, that point is the centre of motion*, he himſelf muſt draw the ſame concluſion; for by his own account the *metacenter* is the acknowledged *prop or fulcrum*; therefore, the *metacenter* and *centre of motion* are the ſame thing. Such an alteration of the original deſtroys its ſimplicity, and introduces the abſurd attempt at making *a lever play upon two fulcrums at the ſame time.*

3d, In page 302 of Mr. *Steel's* work, is a problem entitled---" Of Mooring with two, three, or more Anchors a-head." I confeſs when I read the title, I expected alſo to find two, three, or more anchors aſtern; inſtead of which, after a few introductory lines, I met a problem, from this Treatiſe, entitled, " To let go all the Anchors to the beſt Advantage:" what reſemblance there is between the ſubſtance of this problem and Mr. *Steel's* title, I am at a loſs to diſcover. But it accords with Mr. *Steel's* idea of mooring veſſels extremely well; for in the plate facing page 302 of his work,

work, figures 1, 2, and 3, are repreſentations of ſhips moored with both anchors a-head!

In this edition, the reader will find much new and original matter; alſo, a Syſtem of Naval Signals.

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ERRATA,

which the Reader is requested to alter *with a pen.*

Page 124, line 16, for *bring*, read *bung.*

Page 156, 6th line from the bottom, omit the words *which may have been.*

TREATISE

ON THE

THEORY AND PRACTICE

OF

SEAMANSHIP.

CHAP. I.

Respecting the Properties of Vessels, and the Action of Fluids.

Upon the Floating of a Vessel.

FOR a vessel to float, she must displace a bulk of water equal to her weight; from whence it follows, that as much water as would fill the cavity the ship has made, would be the exact weight of the vessel and her contents. For, imagine a vessel floating in water perfectly tranquil to be suddenly lifted out, the tranquillity will be immediately disturbed, and the water will rush from the surrounding parts to restore the equilibrium, which will not be perfect till the cavity is filled up. Now, if it is confidered that an equilibrium can only be brought about by an equal momentum, it is clear, that the water which now fills up the cavity exerts as much force on its furrounding water, as the ſhip in the former cafe; therefore their weights muſt be precifely alike.

Upon the Centre of Gravity.

The centre of gravity of a body is that point by which it may be fufpended, and the parts remain in perfect equilibrium.

Upon the Centre of Cavity.

By the centre of cavity is meant the centre of the hollow the veffel makes in the water, which is alfo the centre of the force that the water exerts to fupport the veffel.

Upon the Centre of Motion.

Refpecting the place of the centre of motion, authors have differed. To me it appears to be at the centre of the round of the veffel's bottom; and, if the bottom is perfectly circular, that it will not change its fituation, though the centre of gravity of the veffel ſhould varioufly alter.

Let us farther confider this point: fuppofe a hollow cylinder, the half of which in fome meafure approaches the fhape of a veffel, to be loaded at one part of its interior furface till it will fwim in water the depth of its centre parallel to its length; then let it be rolled to and fro, and its centre will be found to have the leaft motion. Now, let the fame load be moved higher up towards the centre of the cylinder, the furface of the water will ftill cut the centre of the cylinder, as the load has not been leffened; and if it be rolled, the centre will yet be found to have the leaft motion.

Again: let the load be reduced, fo that the centre of the cylinder may float above the water; roll it, and it will be feen that the leaft motion is yet in the centre of the cylinder, for the centre cannot be brought nearer to the furface of the water; and in every poffible cafe, be the load light or heavy, and the centre of gravity varioufly altered, ftill the centre of motion will ever be at the centre of the cylinder; from which it may be concluded that the centre of any fimilar body, as a veffel, will alfo be the centre of motion. Having eftablifhed the three foregoing points, we fhall proceed to explain the reafon of the ftability of veffels.

Upon the Stability of Vessels.

The ſtability of a veſſel depends upon the momentum of her centre of gravity, which muſt be placed below the centre of motion; and the greater the momentum, the greater will be her ſtability.

The momentum may be increaſed by two means. Firſt, by augmenting the weight ſo that the centre of gravity may preſerve the ſame diſtance from the centre of motion; or, by placing the ſame weight lower in the veſſel, that the centre of gravity may be removed farther diſtant from the centre of motion. Let us conſider ſtability by the aſſiſtance of a figure.

Let the half circle ABD, plate 1, fig. 1, repreſent the tranſverſe ſection of a veſſel's bottom; HO the ſurface of the water; M the centre of motion; C the centre of cavity; G the centre of gravity; and the line GM the vertical axis of the veſſel, which may be turned round the point M as on a fulcrum conceived to be ſupported by the centre of cavity C. By thus ſimply conſidering the veſſel as a lever in the direction of her vertical axis playing round her centre of motion, it is plain, that if the centre of gravity was placed above the point M, the veſſel would upſet; therefore, that the ſhip may have ſtability the centre of gravity muſt be below this point.

A little

A little reflection will show, that the centre of cavity and motion are ever in the same vertical line to the horizon; but that the centre of gravity may be on either side this line, according to the inclination of the vessel. While G is immediately beneath the centre of motion, its action is to preserve the vessel in her erect state; but directly she is inclined, its action is to reinstate her; and this with a power increasing as the vessel inclines, and as G rises through the quadrant GP. This power is as the horizontal distance of the gravity from the fulcrum, which distance is equal to the sine of inclination; for, let GMg be the angle of inclination, then QM will be the horizontal distance of the gravity from the fulcrum, but QM is equal to g G the sine of inclination—therefore the momentum of gravity, or a vessel's stability with any inclination, may be expressed by multiplying the gravity by the sine of inclination.

Also, if the gravity be placed lower in the vessel, for instance, at B, it is readily seen, that with the same inclination, the stability is greater, for the gravity is removed from the fulcrum, equal to the horizontal distance B b, which is greater than G g.

Upon the Difference of Stability between the Length and Breadth of a Vessel.

Let us now examine why there is so great a difference of stability between the length and breadth of a vessel. A vessel easily inclines round her longitudinal axis, but is with much difficulty inclined round her transverse axis. For this purpose let HO, plate 1, fig. 2, represent the surface of the water; HGO the curve of a vessel's longitudinal section, of which E is the centre; and let the smaller circle represent the curve of her transverse section, of which B is the centre; and G the centre of gravity of the vessel. Now, if the vessel be given an inclination round her longitudinal axis, B is the centre of motion or top of the fulcrum which she turns upon; and supposing the inclination equal to the angle GBK, her stability will be expressed by the gravity G multiplied by GK; but if she be given the same inclination round her transverse axis, in which case E is the centre of motion, her stability will then be as the gravity G multiplied by BI, which is considerably greater than GK. This being the case, it follows, that the force necessary to give a vessel an inclination round her transverse axis, must be as much

greater

greater than the force neceſſary to give her the ſame inclination round her longitudinal axis, as the line B I is longer than G K.

At preſent we have only examined the ſtability of veſſels upon a ſuppoſition that their bottoms are circular; we ſhall now ſhew, that, by increaſing their breadth, the ſtability may be greatly augmented.

Let us ſuppoſe that the tranſverſe ſection, plate 1, fig. 1, be allowed more beam, and increaſed by the dotted lines. Now, when this veſſel is rolled over, it is plain that the cavity will be augmented towards the ſide O, of courſe its centre muſt remove towards O, ſay to E, and as E is ever beneath the centre of motion, erect E m, and where it cuts the vertical axis of the veſſel, that point, in the preſent caſe, will be the centre of motion. Now, admitting that the veſſel be inclined equal to the angle G M g as before, or E M g, which is the ſame; then her ſtability will be expreſſed by the gravity G multiplied by R g, but with this ſame inclination in the former caſe, where the veſſel's bottom was ſuppoſed to be circular, her ſtability was expreſſed by G multiplied by G g, which is conſiderably leſs than Rg. Therefore, by increaſing the veſſel's beam, there is a gain of ſtability equal to the difference of the lines G g and R g. The ſame reaſoning will tend to ſhew, that if the longitudinal ſection, plate 1, fig. 2, was increaſed

increaſed at the bow ſimilar to the dotted curved line, a veſſel's ſtability may be yet more augmented by her build, with reſpect to her length.

For the ſake of ſimplicity, in the foregoing reaſoning reſpecting ſtability, the gravity of the veſſel above the centre of the motion, which is acting in oppoſition to that below, has not been conſidered. Therefore, to have an exact knowledge of any veſſel's ſtability with a given inclination, it will be neceſſary to gain the momentum of the gravity which is above the centre of motion, and the momentum of the gravity which is below the centre of motion; then the momentum above (which muſt ever be the leaſt,) being ſubtracted from the momentum below, will leave the ſtability.

Remarks upon the Stability and Rolling of a Veſſel.

When ſailing in ſmooth water, the greater the ſtability the better; but if a veſſel with a heavy cargo, ſtowed low in her bottom, be ſent out into a rough, tempeſtuous ſea, where every wave will throw her from her equilibrium, ſhe will return with ſuch violence as to endanger her maſts; and ſhould ſhe be diſmaſted, her roll will then be with ſtill greater force, poſſibly to the deſtruction of her hull. Was the cargo in this labouring veſſel to be removed higher up towards the centre

centre of motion, ſo as to leſſen her ſtability, ſhe would be found conſiderably eaſier; her roll would be by ſuch deliberate motions, as to leſſen the danger to her maſts and hull.

The rolling of a veſſel alſo may be conſiderably moderated by increaſing the keel, as practically appears by experiments made on board veſſels with ſliding keels; but as increaſing the keel of a veſſel augments her draught of water, the ſame may be effected by bolting a keel upon the bilge, on each ſide, about a third from the keel to the water-mark, making an angle with the vertical axis of the veſſel of about 15 degrees, as repreſented by plate 1, fig. 14, at E E, that when the veſſel is upon a wind, and inclined over, the lee-keel may be vertical. It is not intended that theſe keels ſhould extend the whole length of the veſſel, but as far as may be thought convenient. Along the bilge, their bottom ſhould run parallel with the proper keel, that in caſe of grounding, a greater number of timbers may bear the weight. Thus three advantages would be acquired, viz. moderating the roll, holding a better wind, and greater ſecurity when grounded.

It is not out of place to remark, that, even in a calm, bracing up the yards and ſetting the ſtay-ſails will very much contribute to moderate the rolling of a veſſel, though certainly at the expence of the ſails.

Upon the direct and oblique Impulses of Fluids.

In considering the impulses of fluids it must be remembered, that it is of no consequence whether the fluid strike the body, or the body the fluid; that is, the impulsion against the bow of a ship at anchor in a tide of three knots, is the same as if the ship sailed three knots through the water.

THEOREM.

A Fluid strikes a Surface perpendicularly as the Square of its Velocity.

DEMONSTRATION.

When a body in motion strikes perpendicularly another, which is at rest, it is with its momentum, that is, with a force equal to its mass multiplied by its velocity; and if the mass of the body be called one, it is easily conceived that a body will strike or impel another with a force that may be expressed by its velocity; but a body moving in a fluid will have to encounter more bodies in the same time as its velocity increases, for with six times the velocity it will encounter six times the number of bodies or particles; and each particle will strike with six times the original force; therefore the body in motion will be shocked

ſhocked by the fluid with an impetus of ſix times ſix, which is the ſquare of the velocity.

For the ſake of an example to elucidate this matter, ſuppoſe ſix ſhots be placed in ſucceſſion at a foot diſtant from each other, and that a body be forced againſt them with the velocity of one foot in ſix minutes; in ſix minutes, therefore, it can receive only the impulſe of one ſhot; but if the body be given ſix times the velocity, in ſix minutes it will have received the impulſe of all the ſhot, and each ſhot, by this increaſe of velocity, muſt ſtrike with ſix times its original force; therefore the body will have received a ſhock equal to ſix times ſix, which is the ſquare of the velocity.

Though a fluid ſtrikes a ſurface perpendicularly as the ſquare of its velocity, yet, *if the ſurface be preſented obliquely to the fluid, its force will then be diminiſhed as the ſquare of the ſine of incidence:* for, if a body or particle as A, plate 1, fig. 3, ſtrikes a ſurface B D at B, with the direction and force A B, it will be deflected off in the direction B E, and impart to the ſurface a perpendicular force B C, which is equal to A D, the ſine of the angle of incidence.

Again: ſhould a ſurface be placed perpendicular to the motion of a fluid or number of particles, it will then be ſtruck by as much as it can oppoſe; but *if the ſame ſurface be preſented* obliquely

liquely *to the fluid, it will not then oppose so much of it by the sine of the angle of incidence:* for, let D C, plate 1, fig. 4, represent the direction of the fluid; A B the surface opposed to it perpendicularly, in which position it will obstruct all the fluid passing between the lines A and B; but if this surface be placed obliquely to the fluid, as A C, it will only obstruct the quantity between the lines A and D, which are separated by the sine of the angle of incidence A C D; therefore the force of a fluid against an *oblique* surface diminishes from two causes; first, because the particles of the fluid, by striking the surface obliquely, do not exert upon it their whole force; and, secondly, because there are not so many particles striking: both of which diminutions following the ratio of the sine of incidence, the total diminution is the square of the sine of incidence.

Upon the Point Velique.

By the point velique is meant that point where a perpendicular from the centre of gravity of a vessel is met by a line in the mean direction of the effort of the water upon the bow. To explain this more clearly: let A B, plate 1, fig. 5, represent the keel of a vessel; B C the curve of the bow; A D a perpendicular through the cen-

tre

tre of gravity; C D the mean effort of the water upon the bow; then the point D is the point velique: and let the force applied againſt D, in a direction to puſh the veſſel onward, be ever ſo great, it can only tend to give her a direct motion, and raiſe her in the water parallel to herſelf; but ſhould the force be applied above that point, the bow will be forced down into the water; if below, the bow will be lifted out of the water; in either caſe altering the trim of the veſſel. This point can only be exactly found when ſailing before the wind; for by ſailing obliquely to the wind, C D will come from the lee-bow, and paſs to windward of the perpendicular without cutting it; therefore in this caſe there will be no determination.

From what has been ſaid of the point velique, it may be eaſily conceived, how neceſſary it is that all veſſels ſhould have their maſts of ſuch a height, that the centre of effort of the ſails may meet, or be the ſame height with it, otherwiſe the forcing the veſſel from her paralleliſm may greatly retard her ſailing, and make her labour extremely, particularly in a high ſea.

Till the ſhapes of veſſels bows beneath the ſurface of the water ſhall be a curve whoſe properties are known, it will be difficult to eſtabliſh by calculation the height of the point velique; but experiment upon a ſmall ſcale would aſſiſt us, though it may not perform all that could be wiſhed.

wiſhed. Thus, let a ſmall veſſel be built perfectly ſimilar to the large veſſel whoſe point velique is required to be known. In this fix a maſt as A D, plate 1, fig. 5, and being properly ballaſted, place it in a trough of water. Now let the veſſel be drawn along by a horizontal line D E, leading over a pully, to which is fixed a weight; and wherever this line ſhall be ſo fixed to the maſt as to draw the veſſel along, in the ſame parallel poſition ſhe floated in when at reſt, there is the point velique. It will be neceſſary to have an upright at the bow of the veſſel, with a ſlit for the line to lead through, that the veſſel may follow in a right line.

Reſpecting the Action of the Wind upon a Sail, and its Centre of Effort.

The action of the wind upon a ſail is perpendicular to its ſurface; and if the wind ſtrikes it perpendicularly, the centre of effort will be the middle of the ſail; but, *if the wind ſtrikes the ſail obliquely, the centre of effort will be removed towards the weather-leech.*

Demonstration.

Let B D, plate 1, fig. 6, repreſent the ſurface of a ſail; A B, C D, the direction of the wind ſtriking

ſtriking the ſail. Now, if C D ſtrike the ſail near the weather-leech, as for inſtance, at D, it will be deflected in the direction D E, and impart a force to the ſail in the direction D F; but if the lee-leech is ſtruck by the wind A B at B, it will be deflected off towards E, and will not impart the ſame force, for A B muſt loſe a great deal of its force by having to paſs through all the deflected wind between D and B. The ſame reaſoning may be applied to the wind's ſtriking any intermediate part of the ſail, and proves that the wind gradually loſes its power as it ſtrikes nearer the lee-leech; which muſt cauſe the centre of effort to approach the weather-leech with an oblique wind. This is practically ſeen by the ſtrain always reſting upon the weather-brace.

Reſpecting the Action of a Sail upon a Veſſel.

The action of a ſail upon a veſſel, if the yard be ſquare, will be to force her in the direction of her keel, either ahead or aſtern; but if the yard be braced up obliquely to the keel either way, the ſail will act two ways, one in the direction of the keel, the other in the direction of the beam; yet though the yard ſhould be ſo braced, as to cauſe the action in the direction of the keel and beam to be alike, ſtill the head-way or ſtern-way will conſiderably exceed the lee-way, becauſe the

the head or ſtern of a veſſel meets leſs reſiſtance from the water than either ſide.

Reſpecting the Action of Sails upon a Ship before and abaft the Centre of Gravity.

Let A E, plate 1, fig. 10, repreſent the longitudinal axis of a ſhip; C the centre of gravity, or point round which the ſhip would turn; A the centre of action of the ſails upon the foremaſt; D the mainmaſt; E the mizenmaſt. Now, ſhould the momentum of D and E act on the ſame ſide, and be equal to the momentum of A, no rotation of the ſhip would follow; but ſhould this momentum be leſſened, or taken off, either before or abaft the centre of gravity, the ſhip will immediately revolve with a leſs or greater motion. From which reaſoning it follows, that with the head ſails full, and the after ſails ſhaking, the ſhip will veer; but with the after ſails full, and the head ſails ſhaking, the ſhip will come to. Likewiſe, if the ſails before and abaft the centre of gravity be equally trimmed, the ſhip will neither fall off nor come to.

RESPECTING THE RATE OF A VESSEL'S SAILING.

THEOREM.—*A Veſſel proceeds in Proportion to the Velocity of the Wind.*

The motion of the veſſel is accelerating, till the preſſure of the water on the bow, to oppoſe her

her courſe, is equal to the preſſure of the wind upon her ſails to puſh her forwards, when ſhe will proceed with a uniform motion, in proportion to the velocity of the wind, *not as its force,* as it is often imagined ſhe does.

It muſt be remembered, that the force or preſſure of a fluid is as the ſquare of the velocity; the velocities 4, 8, 12, producing the forces 16, 64, 144.

A veſſel at firſt getting under way, with the wind a-beam at a velocity of four, will proceed onwards with an accelerating rate, till the preſſure of the water at the bow be equal to ſixteen, (the ſame as the wind upon the ſails) when ſhe will proceed uniformly as the velocity of the wind, ſince the ratio of its ſtrength is counteracted by an equal ratio of preſſure at the bow.—Let it be preſumed, for the ſake of example, that this veſſel ſails a fourth part of the velocity of the wind; then with a wind blowing 4 ſhe will ſail at the rate of 1, and with the wind blowing 48 ſhe will ſail but 12, though its preſſure has increaſed 144 times! After theſe conſiderations, all difficulty will ceaſe: nor ought we to be ſurpriſed at the reduction of a veſſel's rate when hauled upon a wind, notwithſtanding more ſails draw, ſince the preſſure of the wind upon the ſails is reduced as the ſquare of the ſine that the former angle of incidence bears to the ſquare of the preſent, which reduction is greater than the advantage ariſing from the drawing of the head-ſails and ſtay-ſails.

Of the Proportion in which the Wind is apparently leſſened by a Veſſel's ſailing large; alſo in what Proportion more Sail increaſes her Rate.

A veſſel's progreſſive motion apparently increaſes or diminiſhes the velocity of the wind, by as much as ſhe advances to or recedes from its ſource. With the wind right aft, ſhe recedes from it the whole of her progreſſive motion; and with the wind between aft and abeam, ſhe recedes from it *as the co-ſine of the angle contained between the ſtern and the wind.* To explain which, let BF, plate 1, fig. 3, repreſent the direction of the wind, and the radius of the circle the veſſel's velocity in a given time; then, by her ſailing the courſe BA, with the wind upon the quarter, it is evident ſhe will recede from it by the diſtance DA only, which is the co-ſine of BAD, the angle which the wind makes with her ſtern. With the wind abeam, ſhe neither recedes from nor advances to the wind; from whence it follows, that, with a beaming wind, a veſſel muſt continue to ſail faſter, while

more

more canvaſs can be ſpread to advantage, there being (mathematically ſpeaking) no limitation to her rate; but with the wind large, ſpread what canvaſs you will, yet there muſt be a limitation—it being clear, that while ſhe recedes from the force which impels her, in time it muſt loſe its power. Notwithſtanding, *a veſſel will not increaſe her rate in proportion to the increaſe of canvaſs*; that is, with twice or three times the canvaſs, ſet to equal advantage, ſhe will not ſail twice or three times as faſt, but the increaſe will be in the following ratio:—as the quantity of canvaſs at *firſt* ſet, is to the quantity *now* ſet, ſo is the ſquare of the *firſt* rate of ſailing, to the ſquare of the *preſent* rate. For example, ſuppoſe that with 100 yards of canvaſs a veſſel ſhould ſail 4, with 225 yards ſhe will ſail but 6; for 100 is to 225, as 16 is to 36, the ſquare of the acquired rate. This being the caſe, how abſurd is it to carry ſmall ſails at the riſk of the maſts; for if a royal or top-gallant ſtudding-ſail be called a one-hundredth part of the quantity of canvaſs, ſet with a beaming wind, (at which time, let it be preſumed, the ſhip is ſailing ten knots) then it will increaſe her rate but to ten knots $\frac{1}{100}$! A 100, the former canvaſs, being to the increaſed canvaſs, which is 101; as 100, the ſquare of the firſt rate, is to 101 the ſquare of the acquired rate, whoſe root is 10,05, nearly.

In the foregoing reaſoning, we have conſidered what an increaſe of canvaſs will produce with a beaming wind. With the wind large, it will not produce ſo great an effect, on account of the ſhip's receding from it; therefore to gain the quantity of canvaſs that will advance her ſailing to a certain rate, with the wind large, we muſt further increaſe it in the ratio of the ſquares of the different velocities of the wind. Thus for example: Suppoſe a veſſel, with 100 yards of canvaſs ſet, ſails at the rate of 4, with the wind 60 degrees upon the quarter, blowing at the velocity of 16; what quantity of canvaſs is required to make her ſail ſix upon the ſame courſe?—Since the co-ſine of 60 degrees is a proportion of half, the apparent velocity of the wind, when the ſhip ſails 6, will be 15, — 1 being the half of her increaſed rate; therefore, after having increaſed the canvaſs in the ratio of the ſquares of the two different rates of ſailing, which produces 225 yards, ſtill further increaſe it in the proportion that the ſquare of 15, the laſt apparent velocity of the wind, bears to the ſquare of 16, the firſt apparent velocity of the wind, which gives 14 yards; this, added to 225, produces the reſult, 239 yards.

Upon the best Angle to brace a Yard up to, in Oblique Winds, for its Sail to contribute the greatest head-way.

The angle being given between the wind and the keel, it is required to know how this angle should be divided by the yards, that the sails may contribute the greatest head-way.

For this purpose, let KK, plate 1, fig. 7, represent the direction of a vessel's keel; C 6 her beam; AB any of the square-sail yards, as the main-yard; 2.2. the yard braced up 10 degrees more; 3.3. braced up 10 degrees less; WC the direction of the wind. Now, of the angles WC3, WCA, WC2, one must be more advantageous than the others for increasing the velocity in the direction of the keel.

The action of the wind upon a sail, it should be remembered, is perpendicular to its surface, and the force with which it acts is as the square of the sine of incidence; therefore draw perpendicular to the yard, in the three different positions, the forces CD, CE, CF, proportioned to the squares of the sines of the different angles of incidence WC3, WCA, WC2, and they will represent the power of the sail upon the vessel in the three different positions of the yard. Now draw the parallelograms CD, CE, CF, each having two sides parallel to the keel, and two to the

the beam, then these sides will represent the lateral and direct forces arising from the three total forces CD, CE, CF. The direct forces are those only which we need consider. The position of the yard AB gives a direct force of C5; the position 3.3, where the yard is braced up 10 degrees less, gives C4; and the position 2.2, where the yard is braced up 10 degrees more, gives the same, which is less than C5. Now, as either bracing up less or more from the position of the yard AB, gives less, it is evident that the position AB is the best that the yard can make with the keel for increasing the head-way; and this position will never be attained but when the tangent of the angle of incidence WCA is double the tangent of ACK, the acute angle that the yard makes with the keel.

Upon the Effect of the Rudder.

The effect of the rudder is produced by the water passing the vessel and acting upon one side of it; consequently the ship's stern must be forced to the contrary side.

Thus: suppose the tiller was put over to starboard, giving the rudder the position BC, plate 1, fig. 8, and that the vessel be given head-way; then, by the water's passing from A towards B, it must necessarily strike against the larboard side of the rudder, and force her stern towards

D,

D, her head taking the oppofite direction towards F, the veffel turning about fome point (E) before the centre of gravity. On the contrary, let ftern-way be given to the veffel; then, by the water's paffing from B towards A, it muft act againft the ftarboard fide of the rudder, and force her ftern towards H, at the fame time that her head moves towards I; but, when the helm is in the direction of the keel, the water can act no more on one fide of the rudder than the other, therefore no rotation of the veffel will follow.

From the foregoing reafoning the following rule is deduced, which fhould be well remembered.

If the veffel has head-way, the helm, or tiller, being put aftarboard, turns her head to port; if put to port, it turns her head to ftarboard: and if the veffel has ftern-way, the helm or tiller aftarboard turns her head to ftarboard; if put to port, it turns her head to port.

Upon the moft advantageous Angle for the Rudder to make with the Keel.

There certainly muft be one angle more advantageous than the reft for the rudder to make with the keel to gain the greateft lateral power. If a figure be drawn reprefenting a fluid ftriking a furface, as a rudder, at different degrees of incidence, with forces as the ſquares of the ſines of the angles of incidence; upon examining this figure, it will appear that the greateſt lateral impulſe, or that which is in the direction of the beam, will be, when the fluid ſtrikes the ſurface, at about 55 degrees; but then the impulſe in the direction of the keel being much greater than the lateral, is conſequently deſtructive of a conſiderable quantity of the veſſel's head-way. Let the incidence of 45 degrees be examined, and it will be found that the lateral and ſtern impulſes are alike, and that the lateral impulſe is very little leſs than that at 55, while the ſtern impulſe has conſiderably diminiſhed; therefore, it may be concluded, that an angle of 45 degrees is the moſt advantageous for the water to ſtrike upon the rudder, to gain the greateſt lateral impulſe with the leaſt ſtern impulſe. To the bottom of the rudder the water certainly comes in the direction of the keel; but above that point, up to the water mark, it muſt come to the rudder in the different directions of the veſſel's run. The mean ſpread of the run let us ſuppoſe to be 20 degrees, the half (10) will then be the angle which the water makes with the keel when thrown out of its direction towards the bow; therefore, for the rudder to be ſtruck at a mean by the water with an angle of 45 degrees, the tiller muſt move over 35 degrees. This is about

about the greateſt angle that is in general practice, few large veſſels having their tillers to go over more.

The foregoing is the reaſoning of geometricians, and, though perfectly agreeable to truth, is not of that importance which they ſeem to have imagined. The problem required is, *to gain a ſufficient lateral impulſe for the ſteerage of a veſſel, with the leaſt ſtern impulſe.*

This is only to be accompliſhed by increaſing the rudder, and diminiſhing the angle; thus any required lateral impulſe may be gained with an infinitely ſmall angle; but, for this purpoſe, rudders muſt be increaſed to a very great ſize. Admitting that they could be increaſed with ſafety one half of their preſent dimenſions, then with an angle of 20 degrees only, nearly the ſame lateral impulſe would be gained, with about half the original ſtern impulſe. This circumſtance many are aware of, boats being built for the purpoſe of ſwift ſailing, with rudders conſiderably exceeding the accuſtomed proportion.

It may be remarked, that by increaſing the weight of rudders to ſuch an extenſive degree, it will be difficult to ſecure them. Let thoſe who are of this opinion conſider, that as rudders are nearly the weight of their bulk of water, only the weight of that part which is above water reſts

upon

upon the pintles. Should it be further remarked that ſuch rudders will be torn away by the force of the water againſt them, I anſwer, that the whole force of the water againſt theſe increaſed rudders, moved over only 20 degrees, is not ſo great as the whole force againſt the ſmaller rudders, moved over 35 degrees; indeed, it is about one-third leſs. The advantage of theſe increaſed rudders will be, leſs loſs of headway, leſs labour to the helmſman, and, ſhould the veſſel in light winds or in a tide's-way prove ſluggiſh at anſwering the helm, its power may be increaſed double, by admitting it to go over 35 degrees.

It is not my wiſh that rudders ſhould be given their preſent ſhape. Let them be made to reſemble plate 1, fig. 9. Thus there would be no uſeleſs wood above water for the ſea to ſtrike againſt, and they would have breadth where the water ſtrikes nearly in the direction of the keel.

The preſent mode of hanging rudders on a raking ſternpoſt appears liable to ſome objections; for, in the firſt place, when they are moved over, the water ſtrikes with an obliquity which has a tendency to bring the ſhip by the ſtern; and ſecondly, more power is required to overcome the force they naturally exert to return amidſhips. Were they, on the contrary, hung perpendicularly, theſe objections would

be

be done away; and an additional advantage would accrue to the ſteerage, by the rudder being hung farther aft.

Having treated of the neceſſary theory in the preceding pages, we ſhall in the next chapter enter upon the practical part of ſeamanſhip, which every officer, ambitious to be alert at his duty, ſhould make himſelf perfectly acquainted with; that his mind may be as quick to conceive what ought to be done as a ſhip is rapid in her evolutions. Was the young mariner, at his leiſure hours, to employ his mind in reflecting on the various circumſtances to which a ſhip is liable, and apply his theoretical knowledge to the more immediate event in point, his mind would be ſtored with many excellent rules which would readily occur to him at the moment of need.

CHAP. II.

Upon manœuvring a Ship under Sail.

To tack a Ship.

To tack a ſhip, let the ſails be trimmed ſharp, and every man be ſent to his ſtation; hands in the tops to bear the back ſtays abaft and abreaſt, to ſhift over the ſtay-ſail-tacks, &c. and let all the ropes be clear and ſtretched along upon deck; then put the helm down, and call out, *helm's alee, fore ſheet, fore-top-bowline, jib and ſtay-ſail ſheets let go!* The wind out of the main-ſail, *raiſe tacks and ſheets!* and haul well taught the weather after-braces for a good haul. The wind about a point, or two points upon the bow, ſo as to back the weather-leech of the main-top-ſail, *main-ſail haul!* ſharp round with the after-yards, and watch her way; if ſhe has no way, right the helm; if ſtern-way, ſhift it. The after-ſails full, *let go and haul!* round briſkly with the head-yards, and trim all ſharp.

Remarks.

Should it blow freſh, be careful to ſet the back-ſtays up when in ſtays.

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The practice of bracing-to the head-yards, while the ſhip has freſh way, is diſapproved of, as tending to deſtroy it, thus loſing the effect of the rudder, which is of more conſequence: and the reaſon for hauling the main-ſail with the wind upon the bow is, that the wind then taking aback the weather-leech of the main-ſail and main-top-ſail, cauſes the after-yards to fly round of themſelves, bringing the clew of the main-ſail flat aft to its proper place, that the people have only to run in briſkly with the ſlack of the ſheets and braces.

If the water be tolerably ſmooth, and the whole evolution be performed with ſpirit, the ſhip will ſeldom get ſtern-way, and will therefore require only the righting of the helm.

Should the ſhip after coming about fall off conſiderably, let fly the jib and fore-ſtay-ſail ſheets, and keep in the head-yards till ſhe comes to; then brace up, and trim ſharp.

If it be expected, from there being much ſea upon the weather bow, that the ſhip will not come about, it will be proper to haul down the jib and fore-ſtay-ſail before the helm is put alee; and at all times when theſe ſails are ſet, the officer forward ſhould be particularly careful that the forecaſtle-men do not haul over their ſheets too early, which they frequently are guilty of from an over-anxiousness to be forward with their duty, and thus often prevent the ship from staying. While the helm is putting alee, let it be done gradually, and if the ship has quick headway she will seldom require the helm to be put hard over to bring her about.

It sometimes happens that a ship will refuse staying even after the main-sail is hauled, and from that time fall off. In this case, haul up the main-sail, mizen, and mizen-stay-sail; square the after yards, and keep the helm as it was, for she will have stern-way. This position of the sails and helm will cause her to fall off briskly upon her heel. As the after sails fill and she gathers headway, shift the helm, and proceed as if veering.

Having mentioned the manner of tacking a ship, we may now proceed to explain the *large figure* at the beginning of this work, which is intended to assist the reader with a clear idea of the nature of the various evolutions of a ship.

Explanation of the large Figure *at the Front of the Book.*

The circle represents the horizon; the dashed lines across the circle the wind, blowing from the upper part of it. The figure made to turn

in

in the centre of the circle, is a reprefentation of a fhip moving round her centre of gravity before the main-maft, with her fails and rudder, having their names written upon them. The fhade at the head and ftern is intended to reprefent the water paffing either aft or forward, as the imagination may conceive the fhip to have either head or ftern-way. The yards infcribed *fore-yard, main-yard, and crofs-jack-yard,* may be imagined to reprefent the whole of the fquare fails upon each maft, for all the fails upon each maft are as one great fail, having the fame action, but divided into fmaller for the convenience of being more eafily managed.

After this explanation, we fhall go through the evolutions of tacking and veering by the affiftance of *the figure,* which it is to be hoped will clearly demonftrate the neceffity for giving the fails a particular pofition to effect a particular evolution; and at the fame time render its ufe fo familiar, that other evolutions may be attempted without explanation.

Demonftration of tacking a Ship by the Figure.

To tack the figure, trim it fharp to the wind by placing its head in the direction of the line A; then brace the yards up in the directions of the lines CCC, and bear the jib over to leeward. The figure or ſhip is then trimmed ſharp, ſix points from the wind upon the ſtarboard tack. Now put the helm alee, and imagine the fore-ſheet and fore-top-bow-line to be let go, and move the figure gradually to the wind, as if it were done by the action of the rudder, till her head is in the direction of figure 2. In this ſituation it is ſeen that the wind blows right along the yards, of courſe the wind is now out of the ſails; therefore, *raiſe tacks and ſheets!* or ſuppoſe it to be done. Then move her head further round to the direction of figure 3, about a point and a half from the wind, and it is ſeen that the head-ſails are flat aback, which now contributes moſt to force round the ſhip's head, as her way through the water muſt be nearly at an end, and that the wind catches aback the weather-leeches of the after-ſails, therefore, *main-ſail haul!* and brace round ſharp the after-yards. The ſails being now all aback, and the figure moved round head to wind, it may be ſuppoſed that the head-way has ceaſed, and ſternway commenced; therefore ſhift the helm. The figure being moved to bring the wind on the other ſide, bear the jib over to leeward, and keep moving the figure round till its head is in the direction of the line B, when it will be ſeen that the after-ſails are

full;

full; therefore, as the ſhip is ſufficiently from the wind to fill the ſails, *let go and haul!* brace round the head-yards, right the helm, and trim all the yards ſharp in the direction DDD, and the figure is now ſix points from the wind, upon the larboard tack.

To Veer a Ship.

To veer a ſhip, ſend the people to their ſtations; then haul up the main-ſail, mizen, and mizen-ſtay-ſail; put the helm aweather; let go the after-bow-lines, and ſquare away the after-yards. As ſhe falls off, keep ſquaring the after-yards, juſt ſuffering the after-ſails to be barely full. When the wind is nearly aft, raiſe the fore-tack and ſheet; let go the head bow-lines, and ſquare away the head-yards. As the wind comes upon the other quarter, brace up the after-yards; haul aft the mizen, and mizen-ſtay-ſail ſheets; get on board the main-tack, and haul aft the main-ſheet. As ſhe comes-to, brace up the head-yards, and get on board the fore-tack; and when ſhe is to the wind, right the helm, haul flat aft the fore-ſheet, trim ſharp, and haul up the bow-lines.

Remarks.

The method of ſhivering the after-ſails is thought improper, as by tending to diminiſh the head-way much of the effect of the rudder is loſt.

Demonſtration of Veering a Ship by the Figure.

Trim the figure ſharp to the wind, as ſhewn in the foregoing problem; then put the helm aweather, and ſquare the after-yards, in which poſition of helm and ſails it is clear the ſhip muſt veer with rapidity, ſince the power of the after-ſails to counteract the helm and head-ſails is taken away. Keep ſquaring the after-yards, and moving the figure from the wind: when the wind is nearly aft, ſquare the head-yards, and brace up the after-yards; in which poſition they oblige the ſhip to come to the wind, and at the ſame time are not counteracted by the head-ſails. As the figure is made to approach the point D, keep bracing up the head-yards, and right the helm.

To Box-haul a Ship.

To box-haul a ſhip, haul up the main-ſail, mizen, and mizen-ſtay-ſail; raiſe the fore-tack and

and ſheet, and man well the weather head-braces and lee bow-lines; now put the helm aweather; brace ſharp aback the head-yards, and haul up the lee-bow-lines; then ſhiver the after-ſails, and keep them ſhaking as ſhe falls off, which ſhe will rapidly do by the poſition of the helm and ſails. The wind aſt and round upon the other quarter, brace up the after-yards; haul aſt the mizen and mizen-ſtay-ſail ſheets; get on board the main-tack, and trim ſharp the after-yards. As ſhe comes-to, trim ſharp the head-yards, haul up the bow-lines, and right the helm.

To Club-haul a Ship.

Club-hauling is practiſed when it is expected that a ſhip will refuſe ſtays upon a lee-ſhore. To execute it, bend a hawſer from the lee-quarter to a kedge-anchor, prepared for letting go from the lee-bow: now place the hands to their ſtations for putting the ſhip about, and let hands ſtand by the anchor; then put the helm down, and ſhould the ſhip make a ſtand before ſhe brings the wind ahead, let go the anchor and haul the main-ſail. When the wind is ahead, cut the hawſer, and the ſhip will caſt the way required. The after-ſails full, let go and haul.

To make a Stern-board.

To make a ftern-board, haul down the jib and fore-ftay-fail, luff the fhip to the wind, and brace fharp aback the yards fore and aft; and when ftern-way commences, fhift the helm aweather.

The Manner of acting in a Squall.

The manner of acting in a fquall depends fo much on the moment, and on the judgment of the commanding-officer, that it is difficult to prefix any precife rules. Every officer fhould remember, that all accidents which happen through his perfifting to carry fail in a fquall entirely appertain to himfelf. The vigilant feaman fhould ever be attentive to the weather; and if he fees any clouds arife which he has reafon to fufpect carry wind with them, let him make the fhip fnug. For inftance: fuppofe the fhip under a croud of fail with a beaming wind, let the fmall fails, ftudding-fails, and driver, be taken in; and fhould the weather ftill continue to gather, and a hard fquall be expected, let the top-gallant-fails be furled; the jib be hauled down, and ftowed; the mizen-top-fail lowered down, and the lee-clew-garnet of the main-fail hauled up: then place hands by the top-fail-

 haliards,

haliards, and wait the expected wind. Should it come on to blow very ſtrong, keep the ſhip off from the wind, and lower away the top-ſails; when, either reef or hand, as is thought neceſſary.

The Manner of acting when a Ship is brought by the Lee.

When a ſhip is brought by the lee, it is generally occaſioned by neglect of the helmſman during a high ſea and a quartering wind. Thus the careleſs helmſman, by yawing of the ſhip to leeward of her courſe, brings the ſea upon the other quarter, which, ſtriking the ſhip with violence, forces her ſtern round, and cauſes the wind to come broad on the oppoſite beam, throwing all the ſails flat to the maſt. Should the ſhip continue her way, ſhe will, in all probability, recover her ſituation by the aſſiſtance of the helm, and brailing up the mizen and mizen-ſtay-ſail; but ſhould ſhe loſe her way, it will be neceſſary to brace about the after-yards, and even ſometimes the head-yards, to give her freſh way through the water, when ſhe will veer; then trim as before.

To Box a Ship off, and the Method of acting when taken aback.

If a ſhip is in the wind, through neglect of the helmſman, or through the wind coming ſud-

 denly

denly more ahead, by putting the helm aweather, and brailing up the mizen and mizen-ſtay-ſail, if ſhe has head-way remaining, ſhe will fall off; but ſhould the head-way be at an end, ſhe muſt be boxed off: to do which, put the helm alee,—raiſe the fore tack and ſheet,—brace ſharp round the head-yards,—and haul up the lee-bow-lines: in this poſition of the ſails and helm, ſhe muſt inevitably fall round off upon her heel. The after-ſails being full again, brace about the head-yards, right the helm, and trim ſharp as before: *but, ſhould a ſhip be taken flat aback, or through neglect in not timely boxing her off, it ſhould cauſe the wind to be broad upon the other bow, and it ſhould be the wiſh of the officer to have her upon the ſame tack as before,* then put the helm over to that ſide which juſt before was the weather: brail up the mizen and mizen ſtay-ſail; raiſe the main-tack and ſheet, and ſquare the after-yards. In this ſituation of the helm and ſails, ſhe will pay round off upon her heel; and when ſhe has brought the wind aft, and gathered head-way, ſhift the helm. The wind round upon the other quarter, haul aft the mizen and mizen-ſtay-ſail ſheets, brace up the after-yards, get on board the main-tack, and haul aft the ſheet. As ſhe comes to, right the helm, and trim ſharp as before.

Upon Lying-to.

Lying-to may be effected ſeveral ways. The art is to produce a balance between the head and after-ſails, ſo that their effects ſhall counteract each other. When lying-to is intended, the courſes are generally hauled up, as being incommodious.

To Heave-to under the Top-Sails.

A ſhip being cloſe hauled under the top-ſails, mizen, mizen-ſtay-ſail and jib, it is required to heave her to. Thus ſituated, it is only throwing the main-top-ſail to the maſt, and putting the helm a little alee; but ſhould the officer wiſh to prevent her from fore-reaching, let the mizen-top-ſail be thrown ſharp aback to the maſt, and the helm be righted.

Another method is to throw the fore-top-ſail ſquare to the maſt, and to put the helm a little alee; and ſhould ſhe fore-reach too much, let the mizen-top-ſail be braced ſharp aback, and the helm be righted.

Remarks.

As a ſhip will fore-reach while ſhe is lying-to with only one top-ſail aback, ſhe may be kept to the

the wind by the power of the helm; but with two top-ſails aback, ſhe will ſometimes go ahead and ſometimes aſtern, therefore it will be improper to keep the helm either way. For this reaſon ſhe muſt be kept to the wind by the aſſiſtance of the ſails; and as the action of a ſail is perpendicular to its ſurface, the main and mizen-top-ſail being braced ſharp aback muſt contribute a very great lateral force upon the ſhip's ſtern to keep her to the wind. Again, when the fore-top-ſail is braced aback only ſquare, it acts with no lateral power to pay off the ſhip's head, while the mizen-top-ſail, by being ſharp aback, keeps her to the wind. If the ſhip lies well to the wind, the jib had better be kept up in readineſs to veer her.

In different ſituations, both the foregoing methods of lying-to have their particular advantages. If a ſhip is to be brought-to, to windward of another, the firſt method ſhould be practiſed, as then ſhe will be in readineſs to fill and ſhoot clear of the veſſel to leeward, ſhould ſhe drift too near her; but if the ſhip is to be brought-to, to leeward of another, let the ſecond method be practiſed, for, ſhould the windward veſſel drift too near, by bracing ſharp aback the head yards, and ſhivering the mizen-top ſail, the ſhip will fall round off upon her heel.

Of sounding with the Deep-Sea-Lead, and the Manner of Heaving-to, to find Bottom at great Depths.

To gain the true depth in deep water, it is neceſſary that the ſhip ſhall be perpendicular over the lead at the time it arrives at the bottom. While a ſhip's head-way does not exceed three or four knots, and the water be tolerably ſmooth, by paſſing the line the whole length of the veſſel, and ſwinging the lead from the ſprit-ſail-yard, ſoundings can generally be had from 30 to 40 fathoms; but if, from the increaſing of the rate, or the deepening of the water, bottom cannot be gained, the ſhip's head-way muſt be reduced: this, in moderate weather, will ſeldom require more than the taking in the ſmall ſails, and luffing the ſhip carefully to the wind. But if a ſhip be ſailing large with a ſtrong breeze, it will be neceſſary to take in ſail and reduce her to the top-ſails. Now, the line being paſſed along clear to the ſprit-ſail-yard, and the lead ready for heaving; brace-to the head-yards, and luff the ſhip briſkly to the wind; and when the head-way ſhall be ſufficiently moderate to ſuffer the taffarel to come perpendicular to the lead in the time that it could have reached the bottom, then heave the lead. Soundings being gained,

gained, haul in the line briſkly; then put the helm aweather, brace about the head-yards, and trim as before.

The bringing the ſhip briſkly to the wind is a great advantage, as it gives time for the lead to reach the bottom, before her drifting to leeward takes place.

Should a ſhip be dead upon a wind, and drifting conſiderably to leeward, it will be neceſſary to paſs the line from windward, round the bow, to the lee, fore, or main yard arm, and to ſwing the lead as far out to leeward as poſſible, in the direction of the ſhip's drift, that, by her driving, ſhe may paſs over it.

Of Lying-to in a Gale of Wind.

When a ſhip upon a wind is obliged to reduce almoſt the whole of her ſails, through hard blowing weather, ſhe is ſaid to be lying-to, and the more her bow can be preſented to the wind and ſea the better, as ſhe will have leſs drift. The mode of effecting this, is as circumſtances may require. If a ſhip is to be brought-to in a part where other veſſels may be expected to be ſailing in a contrary direction, the beſt ſails to lie-to under are, a reefed fore-top-ſail, mizen-ſtay-ſail, and ſtorm-mizen*, with the helm ſo much alee as

* A triangular ſail to hoiſt upon a horſe abaſt the mizen-maſt, having foot-rope enough to haul well aſt to the taffarel.

is

is found beſt to anſwer the purpoſe. The reaſon for not putting the helm hard alee, which is the uſual cuſtom, is this, that when the helm is hard alee ſhe will come up in the wind and ſhake the ſails, cauſing her to get ſtern-way, and fall round off. On the contrary, were the helm never put ſo far over as to oblige the ſhip to come up in the wind, ſhe would come-to and fall off much leſs: a ſhip thus brought-to will be in readineſs for veering in caſe of neceſſity. Where there is good ſea room, a reefed main-ſail, ſtorm-mizen, and mizen-ſtay-ſail, are excellent ſails to lie-to under, as a ſhip will keep to the wind under theſe ſails without much of the lee-helm, and for that reaſon be very little ſubject to fall off or come-to in any conſiderable quantity.

If the ſea be extremely high, and the ſhip very ſtiff and labouring, ſhe will lie-to better under a main, and even a mizen, top-ſail, which will prevent her rolling ſo rapidly by their lofty ſituation; and as theſe ſails are much above the ſea, they are not likely to be becalmed by the waves.

If a ſhip is to be brought-to in thoſe latitudes where a ſudden ſhift of wind is expected, the courſe ſtay-ſails are the beſt ſails to lie-to-under, as then a veſſel is in readineſs for either tack, let the wind come as it may; and ſhould one of theſe ſtay-ſails be blown away, it will very little affect the ſhip.

REMARK.

REMARK.

The top-ſails are certainly ſuperior to the courſes for lying-to under, as they can be readily braced about, and are much eaſier to take in. If top-ſails be uſed for this purpoſe, it will be found convenient to have a fourth reef, of ſuch a depth as to admit the ſail to be a taught leach, with the yard a foot or two off the cap; and as this part of the ſail is intended for more boiſterous weather than the reſt, it muſt be made of ſtouter canvaſs.

Upon a Floating-Anchor to ride a Veſſel in a Gale of Wind.

The fiſhermen in the North Sea, after they have driven from their anchors, make uſe of, what they term, a drogue-ſail to ride their veſſels by; but this idea is much improved by Dr. Franklin, who has recommended a floating-anchor for that purpoſe, much in the ſhape of a kite, which is made to dive beneath the heave of the ſea.

Such an anchor has long been wanting, and would be of material ſervice to ſhips returning from India round the Cape of Good Hope, in which latitude it frequently happens that they

are

are under the neceſſity of lying-to for ſeveral weeks together.

Conſtruction of a Floating-Anchor.

AB, CD, fig. 11, plate 1, are two croſs pieces of iron, in length nearly half the beam of the veſſel the anchor is intended for, and united by a bolt through their centres, that they may be ſwung together when the anchor is not wanted. At the end of the croſs pieces are holes for the rope ADBC to paſs through, which muſt be hove extremely taught. To this frame is fitted a ſtrong double canvaſs cloth of the ſame ſhape, which is laced taught out to the rope. At the centre of the frame E is a crow-foot of four legs, coming from the croſs pieces on each ſide of the centre, which meet in a loop above the centre towards B, ſo that when the crow-foot is pulled upon, the anchor may incline to the water and dive down, the ſame as a kite riſes in the air. At A is a ring, to which is bent the end of about 12 fathoms of rope, with a buoy at the other end, to prevent the anchor from diving lower than the length of the rope. When this anchor is to be uſed, let a hawſer be bent to the crow-foot, and a ſmall rope to the buoy; then put the anchor overboard, and veer away upon the rope and hawſer to a ſufficient quantity to

ride

ride the veſſel, when it will have the appearance of fig. 12

To get the anchor on board again, haul upon the ſmall rope, which will cauſe it to come flat to the ſurface of the water, in which poſition it may be eaſily drawn to the veſſel. It will be neceſſary to have the mizen-ſtay-ſail in readineſs to hoiſt, to keep the ſhip to the wind till the anchor is hauled on board and placed away.

Upon Reefing.

Reefing ſmartly depends upon practice, and ſtationing the people to advantage.

In blowing weather, taking in a reef is often attended with conſiderable time and labour, from not ſufficiently ſpilling the ſail. To get in a ſecond and third reef, when blowing hard and ſailing large, it will be neceſſary to clew up the ſail, and brace it as much to the wind as poſſible, and to bring the ſhip to the wind in a ſmall degree, if it can be done without hazard. Upon a wind, a ſecond reef may generally be taken in without clewing up the ſail, but a third reef ſeldom. If the ſail be not clewed up, the officer ſhould be careful to haul the buntlines well taught, to prevent the ſails flying up and beating the people off the yard. In reefing a courſe, the points are generally croſſed over:

the head of the ſail and round the yard; as the purport of this does not appear material, and as it takes up much time, when expedition is required it had better be diſpenſed with.

Upon Scudding before the Wind in a hard Gale.

As the wind is perceived to increaſe, and a gale of wind is expected nearly in the direction of the courſe, from the appearance of the weather and the latitude of the ſhip, all expedition muſt be made to prepare the veſſel for ſcudding before the wind and waves. Let the reefs be taken in, and the ſails be furled in time. Let the top-gallant-yards and maſts, mizen-top-ſail yard, mizen-yard, and croſs-jack-yard be got down upon deck, that the ſhip may be as ſnug as poſſible. Let preventer-braces be rove for the lower-yards, and let rolling tackles be hooked to all the yards, and bowſed well taught.

Should the ſea run extremely high, there muſt be no dread of carrying ſail, to give the ſhip as much head-way as poſſible, leſt the ſea ſhould ſtrike the ſhip with violence abaft.

The beſt ſails for ſcudding under are a reefed fore-ſail, and double or cloſe reefed main-top-ſail; if theſe ſails will ſtand the gale, there will be little danger of the maſts.

As,

As, in ſcudding, the ſafety of the ſhip depends upon good ſteerage, great care muſt be taken to have excellent helmſmen, a compaſs by the tiller, and careful people to attend the relieving tackles, as, either through want of experience in the helmſmen, or the breaking of a tiller-rope, the ſhip may be broached-to, and many ill conſequences follow. The officer of the deck ſhould be careful to have the fore-ſheets and preventer-braces clear, with hands to attend them; for ſhould the helmſman broach-to the ſhip by bringing the wind ſo much on either ſide as to touch the ſails, the head-yards muſt be immediately braced up: and ſhould the tiller-rope break with no relieving tackles hooked, or any accident happen to the tiller, the after-yards muſt be braced up, the fore-ſail taken in, and the ſhip hove to under the mizen-ſtay-ſail while the miſchief is repairing.

Upon Steering.

As a compaſs ſuffers much agitation from the motion of a veſſel, and does not return ſufficiently quick to its paralleliſm to point out the abſolute poſition of the veſſel's head, good ſteerage requires further aſſiſtance, which depending upon a quick ſight and nice judgment, is the reaſon we meet ſo few good helmſmen.

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The helmſman muſt not pore over the compaſs, but alternately watch the compaſs, and the motion of the veſſel's head paſſing the clouds, the ſea, or any other objects more fixed than the compaſs, which may happen to preſent themſelves to view. In blowing weather, if one perſon can manage the helm, the feel of it in his hand is a nice criterion of judging whether the veſſel be coming-to or falling-off; ſo alſo is the greater or leſs noiſe or whiſtling of the wind. As the veſſel comes-to againſt the helm, it will feel heavier; and the wind coming more forward will appear ſtronger: on the contrary, as ſhe goes off and gives way to the power of the helm, it eaſes in the hand; and by the wind's drawing aft, it appears to leſſen. Theſe circumſtances, to an attentive and nice obſerver, mark the motion of the veſſel ſooner than the compaſs.

Upon Veering under a Main-ſail and Fore-ſtay-ſail in a Gale of Wind.

To veer under a main-ſail and fore-ſtay-ſail in a gale of wind, watch the ſhip's falling off, then put the helm aweather, eaſe off handſomely the main-ſheet, and gather forward the lee-main-tack. The wind abaft the beam, let go the main-bow-line, and round in the weather-main-brace.

 The

The wind aft, haul down the fore-ſtay-ſail, ſquare the head yards, brace up the after-yards, and haul on board the main-tack. The wind upon the quarter, ſet the mizen-ſtay-ſail, and haul aft the main-ſheet. Be careful now to moderate the ſhip's coming-to, for ſhould ſhe meet a powerful ſea with conſiderable head-way, it may prove extremely deſtructive. The ſhip to the wind, haul up the main-bow-line.

REMARKS.

The reaſon for not ſquaring the main-yard till the wind is abaft the beam is, that the weather part of the main-ſail, when the yard is braced up, being ſituated before the centre of gravity, acts with conſiderable force to pay off the ſhip's head. For making the weather part of the ſail of greater ſervice, the following method is ſometimes practiſed: bend the end of a ſtout rope to the ſlings of the main-yard, then lead it down before the main-ſail to the top-ſail-ſheet-bits, and let it be hauled well taught and belayed; thus when the main-ſheet is eaſed off, the weather-half of the ſail will not loſe any of its power to veer the ſhip. Let a hand ſtand by the rope to let it go when neceſſary.

In a very high ſea it will be attended with danger to veer under a main-ſail only, as by the ſhip's falling off and not quickly gathering head-way, ſhe is liable to be overtaken by the ſea, which may break on board her with conſiderable violence. In this caſe the fore-top-ſail ſhould be ſet, which may be taken in when the wind is abaft, or, as convenient.

Upon Checking a Ship round in a Tide's-way with a Kedge-Anchor and Hawſer.

The practice of checking a ſhip round in a tide's-way is more neceſſary in large ſhips, which are longer in performing their evolutions, than in ſmall. For this purpoſe a boat with a kedge-anchor and crew ſhould be in readineſs to run out a hawſer upon either bow, or quarter, as may be required. Let us ſuppoſe that a large ſhip is ſtanding over to the ſhore under her top-ſails, and it is thought there is not room for her to come round in before ſhe will be on ſhore. In this caſe, hand the end of the hawſer into the boat from the weather-quarter, bend it to the anchor, and pay down a good quantity into the boat; then put the ſhip in ſtays, and ſend the boat round the ſtern to let go the anchor. When the anchor is gone, take a turn with the hawſer, and the tide will preſently huſtle the ſhip to windward; taughten the hawſer and bring her about: then trip the anchor, unbend the hawſer, and haul it on board. Should it be required to veer the ſhip, let the hawſer be handed into the boat from the weather-bow, and let the boat be pulled round the bow, and the anchor be dropped to leeward; thus the tide huſtling the ſhip to windward, will taughten the hawſer, and veer the ſhip round, bringing the wind upon the other quarter; then trip the anchor, and haul in the hawſer.—It will be neceſſary to veer away the hawſer as it taughtens, to prevent its being broke by too ſudden a check.

Upon Drifting to Windward by the Tide.

Where there is not ſufficient room to work in a tide's-way, a ſhip is under the neceſſity of drifting, the art of which is to keep the ſhip in the fair-way, and at the ſame time to manœuvre the ſails in ſuch a manner as will leaſt prevent the ſhip from driving.

If the wind is directly againſt the tide, and the channel is ſufficiently broad, the ſhip ſhould be drifted broadſide to the wind, as the tide will then have the greateſt power to drift her; and could the ſhip be backed aſtern, or ſhot ahead, at pleaſure, ſhe might be kept drifting upon the ſame tack with ſafety; but it happens, that ſhips will never back ſo far aſtern as they will ſhoot ahead. At the firſt of a ſtern-board a ſhip will

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go briſkly aſtern, but will ſoon fall off and drift, with the wind abaft the beam, forging ahead; for this reaſon ſhe muſt be drifted with the helm alee. It follows, as a ſhip will ſhoot more ahead than ſhe can be backed aſtern, that in time ſhe will arrive at the oppoſite ſhore, when ſhe muſt be ſtayed or veered, and drifted upon the other tack. If ſhe is to be ſtayed, (which certainly has the preference, as leſs drift will be loſt by it) let the ſails be filled in time, to give the ſhip ſufficient head-way to bring her about; then put the helm alee. Should ſhe come about, the ſails and helm, having now their proper poſition for a ſtern-board upon the other tack; need not be touched till her ſtern-way ceaſes, when the helm muſt be ſhifted alee, and the head-yards be ſquared to prevent her falling round off; but ſhould the ſhip refuſe ſtays, which is often the caſe*, then

* In a ſtraight regular reach the tide runs ſtrongeſt in the centre, and gradually diminiſhes till within a ſmall diſtance of the ſhore, where the water is either ſlack or runs counter; of courſe, a veſſel ſailing acroſs ſuch a reach, upon a weather-tide, after having paſſed the middle of the reach, will have the tide ſtronger under her lee-quarter than lee-bow, which will very much impede, if not entirely prevent her coming about; and ſhould her head have arrived in the eddy-water, while the tide yet continues to act under her lee-quarter, it is impoſſible ſhe can ſtay. In irregular ſerpentine rivers, counter-tides and eddy-waters are met with at different diſtances from the ſhore: for want of proper attention to this circumſtance, veſſels are often run aground.

brace ſharp round the head-yards, and box-haul her, by which method ſhe will loſe much leſs drift than by veering. If there is not room to give the veſſel way to ſtay or veer her, ſhe muſt be checked round as explained in page 51.

If the ſhip now drifting broadſide is approaching a narrow channel where it would be dangerous drifting in this poſition, ſhe muſt be veered and dropped ſtemming the tide. In this caſe, that the drift may be as much as poſſible, it will be neceſſary to take in ſail, and reduce the ſhip's head-way till ſhe has only ſteerage-way left; thus a veſſel may be dropped through a fleet of ſhips at anchor, without danger.

Should the wind be a little acroſs the tide, a ſhip may be eaſily drifted in the fair-way, with her head towards the weather ſhore; for thus it will be found that ſhe can be backed and filled at pleaſure, and generally be drifted with the ſails ſhivering, in which poſition they oppoſe leaſt power to prevent the drift.

It frequently happens in ſerpentine rivers that the tide ſets acroſs, in this caſe the ſhip muſt be drifted with her head to the ſide from which the tide ſets. Theſe ſets are readily diſcovered by obſerving the opening and ſhutting of two objects in the direction of the channel.

Upon

Upon Kedging, or Drifting in calm Weather by the Tide.

To drift a veſſel by the tide in calm weather, a boat with a kedge-anchor and hawſer muſt be in readineſs to attend. The veſſel is to be kept ſtemming the tide by the aſſiſtance of the boat a-head, and when it ſhall be required to check, or ſteer the ſhip to either ſide, drop the kedge, and gradually check the ſhip; thus, by the waters being made to paſs her, the helm becomes of uſe to ſheer her as required. It is neceſſary that ſmart hands be placed to veer away the hawſer on board, leſt by a ſudden check it ſhould be parted. When the ſhip has got a ſufficient ſheer, trip the anchor, and haul on board the hawſer, which coil away in readineſs to run out again. The London pilots are extremely expert at this manœuvre.

Upon the manner of Kedging in the River Ganges, Bengal.

In the River Ganges, where the tide is extremely ſtrong, the pilots drift the largeſt veſſels with a bower-anchor down. For this purpoſe, the cable is hove in ſhort, and bitted: then to the cable before the bits is laſhed one eye of the

 meſ-

meſſenger, that the cable may be hove in at pleaſure. Thus prepared, let the cable be ſhortened in till the ſhip drives at ſuch a rate as to regulate her ſteerage, which rate may be preſerved by heaving-in, or veering-away cable. But this mode of drifting is carried to a greater extent, when it is required to drift a ſhip a conſiderable diſtance obliquely to the ſtream. The cable being prepared as before, let two ſprings be fixed to the anchor, coming in upon each quarter. Then, by veering-away cable, and holding on the larboard ſpring till the tide be four points on the bow, ſhe will drift in the direction AB, plate 2, fig. 1; and by holding on the ſtarboard ſpring, ſhe will drift in the direction AB, fig. 2. Again, ſhould it be required to drift down with the greateſt force, let her be given the poſition of fig. 3. By a judicious uſe of theſe poſitions, a veſſel may be conducted with facility and ſafety.

Upon Trimming the Sails.

It is neceſſary all ſails ſhould be trimmed, to ſtand as taught as poſſible. The more a ſail is made to approach a flat ſurface, either by or before the wind, the better: the notion that there ſhould be a reef of ſlack canvaſs let out when ſailing large is ridiculous. It is likewiſe neceſ-

neceſſary the ſails ſhould be ſo balanced fore and aft, that the helm may be carried amidſhips, for nothing can be more abſurd than a ſhip's carrying a large driver booming over her taffarel with a turn and a half of weather helm. If the helm cannot be eaſed by ſetting head-ſail, the driver ſhould be taken in, when ſhe will be more under command, and ſail faſter; for the force of the water againſt the rudder in the direction of the ſtern, is greater than the direct effort of the drider, which obliges it to be kept in that poſition; therefore by taking the driver in, and thus ſuffering the ſhip to carry her helm amidſhips, ſhe certainly will ſail with greater velocity. The ſails that will moſt tend to counteract the driver, when the wind is abaft the beam, are the lower and top-maſt-ſtudding-ſails ſet forward: theſe ſails ſtanding out conſiderably from the ſhip, act with a length of lever to pay off the ſhip's head.

It has been demonſtrated that whatever angle the wind may make with a veſſel's head, to gain the greateſt velocity of ſailing, this angle muſt be ſo divided by the yards that the tangent of the angle between the wind and the yards may be double the tangent of the angle formed by the yards and the veſſel's head; though, this rule becomes uſeleſs to three-maſted veſſels when the wind is more than a point abaft the beam, for then

then the after-ſails would obſtruct the wind's filling the head-ſails. But when the wind is upon or before the beam, if the yards be ſo braced that the angles between the wind and the yards may be a point and three quarters greater than the angles formed by the yards and the ſhip's head, then they will be trimmed nearly according to the foregoing demonſtration. Though it may be difficult in practice to exactly follow this rule, yet always be careful that the abſolute angles between the wind and the yards may be more open than the angles between the yards and the ſhip's head, that the ſails may not be kept touching the wind.

If the wind is abaft the beam, the after-yards ſhould be braced more up than the head-yards, that the wind may fill the head-ſails.

REMARK.

The yards of a ſhip do not brace up ſufficiently ſharp to ſail only ſix points from the wind with the greateſt velocity, for in this caſe the yards ſhould be braced up to make an angle with the ſhip's head of 25 degrees only, as was proved page 21, inſtead of which they generally make an angle of 35 degrees.

If the two foremoſt ſhrouds on each ſide were laſhed, or woolded cloſe into the maſt, juſt above the truſsparrels, and the ſhrouds gradually catharpined

pined in, more forward than aft, the yards might be braced up to make a lefs angle with the keel. The bringing thefe fhrouds lower upon the maft will not make it lefs fecure; were fhips to have a fhroud on each fide, to fet up abreaft of the maft, and placed midway to the maft between the catharpins and the deck, they would prove an excellent fecurity, as, before a maft goes it muft have a bend to windward, between the deck and the catharpins, in that part where it is about to give way; but with fhrouds of this kind the bend would in a great meafure be prevented by the lee-fhroud.

A Vane does not fhew the abfolute Direction of the Wind when failing obliquely to it.

On board a veffel failing obliquely to the wind, a vane does not fhew the abfolute direction of the wind, but a direction compounded of the veffel's way and the velocity of the wind. By the vane, a fhip will appear to be lying about four and a half, or five points from the wind; but if fhe is put about it will probably be found that the two courfes differ by thirteen points, which fhews that the fhip was fix and a half points from the wind, when by the vane it appeared to be about five.

Upon the Action of the Jib and Stay-sails.

As the action of a sail is perpendicular to its surface, the jib and most of the stay sails must be rising sails; therefore the jib instead of tending to make the ship pitch, on the contrary will prevent it.

Upon the Position of the Masts.

If the masts are upright, all the square-sails act horizontally, and while their centre of effort is the same height with the point velique, they will not tend to force the ship from her parallelism; but if the fore-mast is stayed forward, which is often a practice, the head-sails will depress the ship; and if the mizen-mast is stayed aft, the square sails set upon it will rise the stern, and still more depress the bow. From which reasoning it appears that all masts should be erect, which certainly has a more beautiful appearance than to see one mast falling over the taffarel, and another tumbling over the bows.

A Ship will not always sail the faster for more Sail.

It does not always follow that a ship will sail the faster for setting more sail. For instance, let us us ſuppoſe that a ſhip in good trim is gliding along perfectly eaſy at as great a velocity as ſhe is accuſtomed to ſail with, and that the centre of effort of her ſails meets the point velique. Now, after this, if another ſail ſhould be added, either above or below the point velique, the centre of effort will no longer meet it, and of courſe the trim of the ſhip will be altered for the worſe: alſo, if the impeding of the ſhip's way, cauſed by a weather-helm, is more than the acceleration ariſing from the after-ſails, which obliges the helm to be kept in that poſition, the ſhip would ſail faſter without theſe ſails.

Upon taking bad-ſailing Veſſels in Tow with the leaſt Detention.

In convoys, where it is found neceſſary to tow, it ought only to be practiſed when the wind is ſteady, and the water tolerably ſmooth, as the loſs ariſing from taking in tow, breaking of hawſers, and probable miſchief to each other, is more than will be otherwiſe compenſated.

If the water be tolerably ſmooth, and the wind moderate, a veſſel may be taken in tow without ſhortening ſail or altering the courſe. For this purpoſe, let the tower ſituate herſelf half a cable, or more, ahead of the tow, adapting her ſail to preſerve that poſition; the tow at the

ſame

ſame time juſt ſteering to windward of her wake. Thus ſituated, the tow is in readineſs to receive under her lee either a buoy or boat, with a ſmall rope to haul the hawſer or tow-line on board. A boat is certainly preferable; if it can be hoiſted in without detention; but ſhould it blow freſh, the ſhips muſt haul the wind, and place themſelves in the above poſition; thus they can reduce their head-way, and back and fill at pleaſure. If the ſhip to be towed is diſabled in her rigging, it may be found neceſſary to heave-to. If ſo, the tower muſt heave-to upon the weather-bow of the tow, otherwiſe, the hauling the tow-line on board will cauſe both ſhips to fall off from the wind before it be properly faſt. The ſize of the tow-line ſhould be adapted to the weather;—ſhips had better be aſunder than tow with a heavy hawſer in light winds. A ſmall rope is ſufficient at theſe times, being careful to haul or heave a larger on board as the breeze freſhens, which can be done without detention.

Upon Chaſing to Windward.

The beſt mode of chaſing to windward is diſputed: many ſeamen think it proper to tack when arrived in the wake of the chaſe. Theoriſts are of opinion, that, *to tack each time the chaſe bears abeam* has the advantage. Let us examine the difference.

difference. If it be granted that there be no advantage or disadvantage gained by ſtaying, a ſhip will ply as much to windward by ſailing 10 miles on one tack, as by ſailing the ſame diſtance on ten different boards, or any number of boards; therefore, whether the chaſer tacks when in the wake of the chaſe, or when the chaſe is abeam, ſhe muſt ever paſs over the ſame diſtance to arrive at her, provided ſhe keeps the wind. After having gained the wake of the chaſe, if the chaſer tacks each time the maſts of the chaſe are in one, ſhe muſt follow in exactly the ſame track; but if the chaſer tacks each time ſhe brings the chaſe abeam, ſhe will follow, during the purſuit, a track to leeward of the chaſe's track, but gradually approaching it till ſhe joins her. Thus, let CDE, plate 2, fig. 4, repreſent the track of a chaſe: if the chaſer A, upon diſcovering the chaſe C, ſtands towards B, till ſhe arrives at the wake of C, then ſtands after her, following her wake, ſhe will ſail through the ſame track, till ſhe joins her at E; but if the chaſer tacks each time the chaſe is abeam, ſhe will paſs through the dotted track, to leeward of the other, till ſhe joins her at E.

By the firſt method, after gaining the wake of the chaſe, no more tacks are made by the chaſer than the chaſe; but by the ſecond, a much greater number are made, which gradually become

quicker

quicker and ſhorter. If the water be ſmooth, and the chaſer works quick, keeping freſh head-way in ſtays, it will certainly be moſt advantageous to follow the laſt-mentioned plan; becauſe ſhe gains to windward in ſtays, and becauſe, by plying cloſe under the lee of the chaſe, ſhe forces her to keep her wind, and prevents the poſſibility of an eſcape while day-light remains. The objections to the firſt method are, that, if the veſſels be far diſtant, by A's ſtanding to gain the wake of C, ſhe would be removed too far to obſerve her motion; and when the wake is gained, ſhe leaves the chaſe at liberty to bear up.

Upon ſumming up theſe facts, it may be concluded, that while the chaſer works quick, to tack when the chaſe is abeam is preferable. But if it be found that tacking is diſadvantageous, let tacking a beam be practiſed only till the chaſer may ſtand for the wake of the chaſe, without too great a ſeparation, but by no means ſtand beyond the wake; on the contrary, rather tack ſhort of it, ſo as to have the chaſe, when on the ſame tack, open on the weather-bow.

Upon Chaſing to Leeward.

To purſue a chaſe to leeward, the chaſer muſt ever keep her at the ſame bearings. The reaſon of this will appear by the aſſiſtance of a figure

figure, plate 2, fig. 5. Suppose A, the chaser, discovers B, the chase, standing along the course BC; then let the course of A approach their line of bearings AB, by such a quantity, as will preserve B on the same point of the compass. When A has arrived at D, B continuing her first bearings, must have arrived at E; for the distance A.D, is to the sailing of the chaser, as BE is to the sailing of the chase; and if AD be continued till it cuts the course of the chase, the cutting-point will be their point of meeting, and shews the distance each must sail before they join; for the respective legs of the triangle AC and BC are proportional to the sailing of the two vessels: that is, by A's preserving B at the same bearings, they both pass through, at the same time, two legs of a triangle, which are each respectively proportional to their sailing.

Instead of shaping such a course as to preserve the chase at her original bearings; suppose the chaser (which is often done) should haul for the chase keeping her directly ahead throughout the pursuit, what will be the consequence?—that to arrive at her, she must sail through a much greater distance in a curved line (as represented by the dotted curve in the triangle; steering through all the different courses contained between the lines AB and A.C.

Obſervations for the Chaſe.

If the chaſe be cloſely plied to windward, by the chaſer continuing under her lee, ſhe muſt not attempt to bear up, but continue her courſe to the utmoſt, in hopes of being favoured by night. Should the chaſer tack in her wake, and be far diſtant, it is in the power of the chaſe to bear up, if it be thought beneficial; but this muſt be done in a ſlight degree only, for, if the chaſe bears up much, it will ſhorten the diſtance of the purſuit.

When it is diſcovered by a veſſel to leeward that ſhe is chaſed, (granting that ſhe ſails as well with reſpect to other veſſels by the wind, as large) ſhe muſt ſteer directly away, making her courſe oppoſite to the bearings of the chaſer, as this courſe muſt prolong the purſuit more than any other.

If the chaſe be far to windward, ſhe has little to fear, as a purſuit to windward is prolonged beyond one in a direct courſe of the ſame diſtance, by the difference of time required between ſailing direct, and working to windward: this difference is about three to one.

Remark.

When chasing, the bearings of the chase must be accurately observed with an azimuth compass. If the chase cannot be preserved at her first bearings, she sails better than the chaser.

Upon Sailing against a Sea.

Making sail against a head-sea is attended with considerable danger, particularly if the sea be short; thus when one sea has passed abaft a vessel's midships and depressed her head, she will be met by a second before her head has risen, which will shock and pass over her with a force expressed by the square of the united velocities of the ship and sea; therefore, by reducing the head-way, it will diminish the power of the waves. If this be accomplished by taking in the square-sails forward, it will also prevent her pitching so deep into the sea.

It is a custom when a sea is seen coming upon the bow to put the helm down, and thus cause the ship to meet it. This practice, I should imagine, must have arisen from its relieving the person who is steering from the weight of the helm, which is greater as the sea passes aft and strikes the rudder; for it is attended with the expreſſions, "*Eaſe her, eaſe her!*" but it does not appear that the pitching is in the leaſt prevented: the helmſman being eaſed of his burden, it is concluded the ſhip ſuffers a general relief. However, it has the advantage of eaſing the rudder, from the ſudden jirk of the ſea, and prevents the ſhip being thrown off from her courſe; but if a towering ſea is obſerved coming upon the beam, it would be the height of imprudence to put the helm down; rather put it up, and thus diminiſh the force of the wave by running from it.

We cannot conclude this chapter, without particularly adviſing the practice of keeping the people to fixed ſtations. By frequent cuſtom, the evolution becomes familiar. Therefore, let ſtation-liſts be made out for the principal manœuvres, as "tacking, veering, furling ſails, reefing, and heaving up the anchor."

CHAP. III.

Upon Coming to an Anchor.

When a ſhip is coming to an anchor, ſhe ſhould always be under eaſy ſail, as, the top-ſails, jib, and fore-ſtay-ſail, mizen, and mizen-ſtay-ſail.

To bring a Ship to an Anchor with a Side-wind where there is no Current.

To bring a ſhip to an anchor with a ſide-wind where there is no current, let the ſail be reduced to the top-ſail; and when ſhe ſhall be within a few ſhips' length to leeward of her anchoring-birth, put the helm alee, haul down the jib and fore-ſtay-ſail, clew up the fore and main-top-ſail, and throw the mizen-top-ſail ſharp aback to the maſt. When ſhe has ſtern-way, let go the anchor, right the helm, and give the ſhip the neceſſary cable; then ſend the hands up to furl the ſails.—Thus, ſuppoſe a ſhip ſailing with a ſide-wind, in the direction of AB, plate 2, fig. 6, and that C is the birth fixed upon to anchor her; when arrived at B, a certain diſtance to leeward of C, let her be brought to the wind, and if the

 point

point B has been well eftablifhed, the fhip will perform the curve BC; when, let go the anchor.

To come to an Anchor with the Wind aft, where there is no Current.

When coming to an anchor, with the wind aft, where there is no current, if the fhip has frefh head-way, it will be proper to take in the main-top-fail while the fhip is yet in the offing. The anchoring-birth being fixed upon, fteer the fhip to a fmall diftance on one fide of it: when nearly abreaft of the anchoring-birth, put the helm hard over, haul out the mizen, and haul aft the mizen ftay-fail fheet, to luff the fhip fmartly to her fituation; clew the fore-top-fail up when it fhakes, brace fharp aback the mizen-top-fail, and let go the anchor when the fhip has ftern-way.

For inftance, fuppofe a fhip failing into a road-ftead in the direction of DA, plate 2, fig. 7, with the wind aft, and that C is the place fixed upon to anchor her; when arrived at the point A, let her be brought to the wind; and if the diftance of the point A from C be well judged, the fhip will perform the curve ABC, juft reaching her birth.

Remarks.

Should it blow hard, the fhip muft be made as fnug as poffible while in the offing. All fails that can be ſpared ſhould be furled, and top-gallant-yards got down. Both the bower cables muſt be ranged, or the beſt bower and ſheet, and great care taken that every thing be clear about the anchors.

In ſeeking out an anchoring-birth, attention is to be paid to the buoys of the ſhips at anchor, leſt their cables be over-laid.

To come to an Anchor without Tending.

It ſometimes happens that a ſhip is to be brought up in a place where there is not ſufficient room to tend her. In this caſe reduce her head-way as much as poſſible, before ſhe comes to her anchoring-birth.

To come to an Anchor upon a Weather-Tide.

To come to an anchor upon a weather-tide, the ſhip ſhould be ſo ſteered as to be brought to her birth ſtemming the tide, and ſhot ahead of her anchor.

To come to an Anchor upon a Lee-Tide.

To come to an anchor upon a lee-tide, the ſhip muſt be brought to her ſituation, if poſſible, upon that tack which will moſt admit her head ſtemming the tide, in order to bring up with greater eaſe. Should it blow hard, and the tide be ſtrong, the ſquare-ſails had better be furled while the ſhip is yet in the offing, and the ſhip be run into her anchoring-birth under the ſtay-ſails. When the ſhip is arrived at her intended ſituation, put the helm alee, haul down the fore-ſtay-ſail, and ſet the mizen and mizen-ſtay-ſail, to bring the ſhip rapidly to the wind; then let go the anchor, before ſhe loſes her way and falls off from the wind.

Upon this occaſion, both bower-cables, or beſt bower and ſheet, ſhould be ranged and bitted, in caſe of parting. If the firſt cable be not thought good enough to bring the ſhip up, when about a third of it is out, let go the ſecond anchor, and veer away upon both cables. This anchor muſt be hove up before the ſhip tends for the weather-tide.

When a ſhip is expected to bring up extremely hard, it is an excellent plan to range the cable, and bit it to the foremoſt bits, then to haul up a ſecond range, and bit it to the after-bits, that the cable thus doubly bitted may be wore away with eaſe: this mode of bitting is repreſented in plate 2, fig. 8. Great care muſt be taken that the after part of the ſecond range be abaft the after-part of the firſt.

To

To let go all the Anchors to the best Advantage.

When it is found that a ſhip cannot clear the ſhore under her lee by ſailing, owing to the ſtrength of the wind and the height of the ſea, the laſt reſource is to come to an anchor with all the anchors in the beſt poſition. For this purpoſe, let the cables that are bent be got clear for running. Then furl all the ſquare ſails with as much expedition as poſſible, and ſhoot the ſhip along the ſhore under the ſtay-ſails. When the ſquare-ſails are furled, let go the weathermoſt anchor, and veer away briſkly the cable; then let go the next weathermoſt, and ſo on, till all the anchors are gone, nearly in a line along the ſhore; thus when the ſhip becomes wind-rode, all the cables may be made to bear an equal ſtrain, and are ſeparated from each other.

CHAP.

CHAP. IV.

Of keeping a clear Anchor.

The art of keeping a clear anchor is thought to be a difficult branch of ſeamanſhip, but I believe only from its being ſo ſeldom practiſed by the generality of ſeamen, particularly by thoſe who ſail long voyages; thoſe ſeamen not being often in a tide's-way at ſingle anchor without having a pilot on board, whoſe duty is to tend the ſhip at high and low water.

Upon the Nature of Sheering a Veſſel to one Side of her Anchor.

If the ſide of a ſhip at anchor is preſented to the tide by any means, the water will act upon her two ways, one in the direction of her keel, the other in the direction of her beam, which laſt will cauſe her to ſheer out to one ſide of her anchor, which before was ahead. Suppoſe, for example, the power that preſents the ſhip's ſide to the tide was a ſpring from the anchor coming in aft on the ſtarboard ſide; upon heaving in the ſpring, the ſhip will ſheer over to port, bringing

bringing the anchor upon the ſtarboard bow. The more the ſpring is hove in, the more the ſhip will go ahead and over to port, till her ſide makes an angle with the tide of 45 degrees, when ſhe will be the fartheſt over from her anchor that ſhe can go; and if the ſpring is hove in after this, the ſhip will return, and be in the ſtream of her anchor when ſhe is hove round broadſide to the tide. Now if the helm is put over to ſtarboard, it will act the part of the ſpring, by forcing the ſhip's ſtern to ſtarboard, and thus by cauſing the water to act upon her ſtarboard ſide, the ſhip will be forced over to port: and if the helm had been put aport, the larboard ſide would be preſented to the action of the water, and the ſhip would go over to ſtarboard: but the power of the rudder being according to the ſtrength of the tide, which ſtrength leſſens upon the rudder as the ſhip ſheers obliquely to the ſtream, it can never produce ſo great an effect as the ſpring.

REMARKS.

It ſhould be a practice to ſhoot a ſhip, if it can poſſibly be done, on the ſame ſide of her anchor at each change of tide, that the danger ariſing from the anchor's not turning as the ſhip ſwings may be avoided; for ſhould the anchor not turn in the ground, the cable will get foul about

about the upper fluke or ſtock, and either trip it out of the ground, or damage the cable. It often happens, when an anchor is tripped out of ſtiff ground, that it will not take hold a ſecond time without the upper fluke ſhould cant down; for the quantity of clay that adheres to the fluke prevents its digging into the ground afreſh, ſo the anchor keeps tripping over the ſurface, and another anchor muſt be let go before the ſhip can be brought up.

As a ſhip by being ſheered preſents one bow to the tide, if the wind is directly againſt the tide, it muſt blow upon the oppoſite quarter.

To tend a Ship for a Weather-Tide.

Let us ſuppoſe a ſhip riding at ſingle anchor upon a lee-tide, with the wind in the direction of the tide, and that it is required, upon the tide's ſetting to windward, to tend the ſhip clear of her anchor. For this purpoſe, when the weather-tide ſets, and brings the wind broad upon either bow, hoiſt the jib and fore-ſtay-ſail with the ſheets aft; and if there is little wind, brace full the yards, and ſet the main-top-maſt-ſtay-ſail to ſhoot the ſhip a taught cable from her anchor. Now put the helm alee, and wait till the tide ſettles the ſhip over to windward of her cable,

the

the buoy coming upon the ſame ſide that the helm is put over to; after which, ſhould the wind blow ſo freſh as to ſhoot the ſhip end-on with the cable, brace-to the head-yard, and keep the after-yards full to aſſiſt the helm. If from little wind the buoy bears nearly abeam, the jib and fore-ſtay-ſail may be hauled down; but if the wind blows freſh,* and ſhoots the ſhip nearly end-on with the cable, bringing the buoy upon the quarter, it will be neceſſary to keep the fore-ſtay-ſail up, as in this ſituation the ſhip will be in danger of breaking her ſheer againſt the helm, and the fore-ſtay-ſail will be in readineſs to catch her before ſhe can fall to windward of her anchor. As the weather-tide ſlacks, the ſhip will gradually fall wind-rode, when haul down the fore-ſtay-ſail and right the helm; and ſhould it blow freſh, let the yards be braced forward, and the ſhip be given the neceſſary cable.

To Tend a Ship with the Wind a few Points acroſs the Tide.

Let us ſuppoſe a ſhip, riding lee-tide with the wind two or three points upon the bow, is to be ſwung for a weather-tide. When the lee-tide

* Riding end-on with the cable, and the wind aft, is termed *Riding-trade.*

is

is done the ſhip will become wind-rode, of courſe muſt ſwing with her head to the weather-ſhore. As the tide makes to windward and brings the the wind broad upon either ſide, hoiſt the jib and fore-ſtay-ſail with the ſheets aft, to ſhoot the ſhip a taught cable from her anchor. If there is little wind, let her be aſſiſted by the main-top-maſt and mizen-ſtay-ſails, and filling the yards. When the tide has ſet the ſhip over to windward of her cable and thus brought the buoy upon the lee-ſide, put the helm a-lee, haul down the jib and fore-ſtay ſail, and if it blows freſh, brace to the head-yards and fill the after-yards, in which poſition ſhe will lay quiet the remainder of the tide. As the weather-tide ſlacks, the ſhip will ſhoot end-on with the cable, and gradually fall wind-rode, when, ſhould it blow freſh, let her be given the neceſſary cable before the lee-tide makes ſtrong, and the yards be pointed to the wind.

To Tend a Ship with the Wind acroſs the Tide.

When the wind is acroſs the tide, the ſimpleſt method of tending a ſhip is to keep her both tides to leeward of her anchor. At each ſlack water the ſhip will become wind-rode, and as ſhe tends, and brings the wind on either ſide, put the helm aweather, and hoiſt the fore-ſtay-ſail with

with the ſheet to windward, to force the ſhip a taught cable from her anchor. When the tide is ſet, and the ſhip upon a proper ſheer to leeward of her anchor, the fore-ſtay-ſail may be hauled down.

Of keeping a clear Anchor in Calm Weather.

In calm weather, when aſſiſtance cannot be given to a ſhip by ſail to keep the cable clear of her anchor, but ſhe is in danger of falling over it, or on the wrong ſide; then, as the tide ſlacks, let the cable be ſhortened in, eaſing the helm as the ſhip comes to the anchor.

Demonſtration of the preceding Rules.

By the aſſiſtance of fig. 9, plate 2, the reaſon of the preceding rules will appear clear. Suppoſe the ſhip A riding lee-tide: when the tide ſets to windward in the direction AG, it will cant the ſhip either one way or the other, ſay to the poſition of B; and ſhould ſhe be ſuffered to lay in this ſituation, it is poſſible ſhe might fall over the anchor: therefore, to prevent it, hoiſt the jib and fore-ſtay-ſail, and fill the yards, as ſhewn in the figure, and ſhe will gradually ſhoot over and fall to windward by the tide to the poſition C, her ſtern coming to the wind by the tide's act-

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ing upon her larboard ſide; and by putting the helm alee, the tide will be preſerved on the larboard ſide, which will oblige the ſhip to paſs over her cable, bringing the buoy upon the lee-ſide; and by bracing-to the head-yards, filling the after-yards, and ſetting the mizen and mizen-ſtay-ſail, they will contribute to continue this poſition.

Should it blow freſh, it is readily conceived the ſhip muſt ſhoot to the poſition of D; or ſhould it leſſen, that ſhe will gradually fall with a taught cable to the poſitions E or F, according to the ſtrength of the wind compared with the tide. While the veſſel remains with a ſheer in the poſition of D, ſhe cannot come near her anchor at ſlack water, for ſhe is immediately to leeward of it, and will fall wind-rode to the poſition A without trouble; but if the veſſel be in the poſition F, to windward of her anchor, ſhe muſt be ſhot with a taught cable towards E and D, when ſhe will gradually fall wind-rode as the tide ſlacks. Should there not be ſufficient wind to ſhoot the ſhip from the poſition F, as the tide ſlacks, the cable muſt be hove in till it is up and down, gradually eaſing the helm as ſhe comes to the anchor.

If the ſhip riding in the poſition of D break her ſheer and come athwart the tide, bringing the wind upon her beam, ſhe is liable to be driven over her anchor by the ſtrength of the tide act-

ing

ing on her lee-ſide. If, therefore, the fore-ſtay-ſail be kept up, it will catch the ſhip upon thwarting the tide, and veer her to her ſituation before ſhe can have dropped to windward over the anchor.

Again, ſuppoſe the wind acroſs the tide in the direction AB, plate 2, fig. 10, at ſlack water, the veſſel muſt be to leeward of her anchor in the poſition B, by the ſtrength of the wind: as the tide makes from either C or D, ſhe will ſwing to the poſition of E or F, and may, with the helm aweather, aſſiſted by the fore-ſtay-ſail, be kept taught to leeward of her anchor A, without a poſſibility of coming near it.

Remarks.

It ſhould be remembered that, to ſheer a veſſel, it is not always neceſſary to put the helm hard over, (for by this means, in a ſtrong tide, ſhe may be ſheered adrift) but adapt the helm to circumſtances.

It will not be always neceſſary to make uſe of the yards in tending a ſhip to ſhoot her a taught cable from her anchor. In general, the jib, fore-ſtay-ſail, and main-top-maſt-ſtay-ſail will be quite ſufficient for this purpoſe.

Should the wind ſhift at any time, it will be neceſſary to alter the ſheer of the veſſel accordingly.

If there is the leaſt ſuſpicion of the ſhip's having come near her anchor, it ſhould be ſighted the firſt opportunity.

There are road-ſteads where an anchor will ſo completely bury itſelf, that the bight of the cable can never foul it. In ſuch places it would be better, ſhould there be room, to lay at ſingle anchor than to moor.

At ſingle Anchor, when to let go a ſecond Anchor.

In a tide's-way, at ſingle anchor, a ſecond anchor ſhould never be let go, but when abſolutely neceſſary; for with a long ſcope of cable, a ſhip will ride more eaſy than with a ſhorter ſcope upon two cables. Further, ſhould a veſſel happen to drift athwart hawſe in a gale of wind, there will be only one cable to cut: but how dreadful is the ſituation of that veſſel which has cut from two anchors, and probably not another remaining at her bow!

If your ſhip ſhould be in the hawſe of another, it will then be neceſſary to drop a ſecond anchor under foot.

REMARK.

REMARK.

When riding in a gale of wind, the deep sea-lead ſhould be kept overboard, and often attended, that the officer may be aſſured the ſhip rides faſt.

Upon Veering away Cable in a Gale of Wind.

Veering away cable in a gale of wind requires great precaution. Should it fortunately be bitted, as repreſented plate 2, fig. 8, the cable may be wore away with conſiderable eaſe; but if not, before the ſtoppers are taken off, let the cable be put over the bit-head; thus, when the ſtoppers are taken off, and the cable taught about the bits, it will have the appearance, as repreſented plate 2, fig. 11, and may be wore away with as much eaſe as by bitting the cable to both bits.

REMARK.

The general defect of bits is their not being ſufficiently large, and the bit-head is too ſhort to admit a ſplice going round clear of the crow when the cable is bitted, as repreſented by fig. 11.

CHAP. V.

Upon Mooring, &c.

It ſhould be a rule to moor in a road-ſtead with the beſt cable and anchor to that quarter where the ſtrongeſt wind and the higheſt ſea are expected from; but in rivers, or in a tide's-way, where freſhes are expected, the beſt anchor and cable ſhould be layed to the ebb.

To Moor in a Tide's-way.

Let us ſuppoſe a ſhip is about to be brought up at high water, and it is intended to moor with the beſt bower to the ebb. In that caſe, ſhe ſhould be brought up with the beſt bower, and the cable ſtoppered till the ebb makes ſtrong; then veer away two cables, and, if it can be done, aſſiſt her aſtern with the mizen-top-ſail. If, when the two cables are out, and the ſhip in the ſtream of her anchor, it is thought when moored ſhe will ride too near any particular veſſel, ſheer her over from that veſſel, and let go the ſmall bower anchor. Now ſhip the capſtern bars; bring-to the beſt bower; veer away the ſmall

ſmall bower; and heave in the beſt bower to the whole cable ſervice; then ſtopper the cables and bit them, remembering to leave ſufficient ſervice within board to freſhen hawſe.

To Moor with a Swivel, half a Cable each Way.

To moor with a ſwivel half a cable each way, hang the ſwivel over the bows and bend to it the cable which is intended for the long bridle from the outer hawſe-hole. The firſt anchor being let go, veer away to a half-cable, and laſh the middle of the cable in the form of an eye, to which eye laſh the ſwivel, and veer away upon both bridle and cable till the inner end of the cable can be got at to bend to the ſecond anchor. The ſecond anchor being let go, heave up to the ſwivel, and bend a ſhort bridle from the other ſide of the ſtem, to guy the ſwivel amidſhips of the hawſe. It will be neceſſary to have a good buoy-rope to one of the anchors, to unmoor with:—this had better be ſlightly ſtopped along the cable, ſo that its end may be got at by under-running the cable, which will put it out of the way of being ſtolen.

To Moor with an open Hawſe to any particular Quarter.

To moor with an open hawſe to any particular quarter, let us ſuppoſe, for example, the road-ſtead, or river that the ſhip is to be moored in, to lie north and ſouth, (in which direction the anchors are to be laid) that ſhe carries her beſt bower on the larboard ſide, and it be requeſted that when moored, the ſhip ſhall have an open hawſe with her head to the eaſtward. In this caſe the beſt bower muſt be the northern anchor. But if the hawſe had been required to be open where her head was ſwung to the weſtward, the beſt bower muſt have been the ſouthern anchor. This will appear clear by conſidering figure 12, plate 2, where N. E. S. W. repreſent the points of the compaſs.

Of keeping a clear Hawſe.

When a ſhip is moored, many officers think themſelves in ſo perfect a ſtate of ſafety, or their minds are ſo much employed about the taking in or delivering the cargo, that the keeping the hawſe clear is too much neglected.

If the hawſe is clear, the ſhip muſt ever ſwing with her ſtern to the ſide the headmoſt cable leads

leads of: if ſhe ſwings contrary to this, ſhe will make a croſs: if ſhe ſwings a ſecond time wrong ſhe will make an elbow; and a third time, will make a round turn, in which ſituation it will be impoſſible either to heave in or veer away cable, let the caſe be ever ſo urgent.

If, to keep the hawſe clear, the ſhip ſhould ſwing with her ſtern to windward, it will be impracticable to get her the right way by any ſail that can be ſet; for as the tide ſlackens ſhe will naturally fall wind-rode, and when the tide ſets, it will take her upon the wrong ſide: however, if the wind continues, ſhe cannot foul her hawſe any more, as at the next tide the ſame wind will undo the croſs it cauſed. When the wind is either ahead or aſtern, by the aſſiſtance of the mizen-top-ſail or jib the ſhip can generally be made to ſwing the right way, provided the tide does not alter its direction as it ceaſes to run. For example, let us ſuppoſe the wind ahead, or even a little upon the ſtarboard bow, and that the ſhip's ſtern is to ſwing to ſtarboard:—in this caſe, ſet the mizen-top-ſail with the ſtarboard yard-arms braced forward; haul up the ſtarboard bow-line; hoiſt the jib, with the ſheet to windward; and before the lee-tide is done, put the helm to ſtarboard to give the ſhip a ſheer, which will be preſerved by the poſition of the ſails. Now watch the tide, and at ſlack water ſhift the helm: thus when the tide makes, it will act againſt the larboard ſide of the rudder and ſtern, and very much aſſiſt to ſwing the ſhip the right way. Again, ſhould the wind be aſtern and a little upon the wrong quarter, if the helm be attended as before directed, and the mizen-top-ſail braced full the right way, in all probability the ſhip will ſwing as required.

However, ſhould this attending to the ſails break the people too much off from their neceſſary harbour duty, if the helm only was properly regarded, it would often ſave the labour of clearing the hawſe.

REMARK.

It will be proper at all times to have a rope and ſmall anchor in readineſs abaft, to run out and haul the ſhip round in calm weather.

Upon clearing Hawſe.

Clearing hawſe can ſeldom be attempted when the ſhip does not ride by the clearing cable. To execute it, bend a fiſh-hook to a rope prepared from the bow-ſprit-end. Now hook the cable the ſhip is riding by, below the turns in the hawſe, and bowſe it well up out of the water; then laſh the cables together at the lower part of the turns. If the cable by which the hawſe is to be cleared leads on the ſtarboard ſide, ſend the larboard fore or fore-top bow-line into the hawſe-hole under the cable; or under and over, according as the cable to clear with is either below or above the other, which muſt be bent about three fathom within the hawſe. Then ſend in the ſtarboard bow-line, which let be bent well in towards the end of the cable, and ſtopped along the cable at about every fathom; and let a hawſe rope be bent to the end of the cable. When all the bowlines are faſt, unbit the cable, and haul out upon the ſtarboard bowline; let a hand cut the ſtops as the cable comes out of the hawſe; and when a long bight is out, haul upon the larboard bowline, and trice this bight up to the bowſprit. Should this one bight not ſufficiently expend the cable, that its end may be taken round the other, hang it to the bowſprit, and ſend down the larboard bowline for a ſecond bight. When the end of the cable is round the other, ſhift the hawſe-rope and haul it in again. If the hawſe is now clear, bit the cable and unlaſh, otherwiſe the end muſt go out again, and be paſſed round the cable the ſhip is riding by, till the hawſe is perfectly clear.

Remarks.

Should it blow freſh, and the tide run to windward, it may prove dangerous truſting to the

laſhings.

lashings alone, lest the cable should run out end for end. In this case, bend a hawser with a rolling hitch to the clearing cable below the turns in the hawse, and let it be hove well taught as a double security.

If the weather is moderate, and the tide easy, the hawse may be readily cleared notwithstanding the ship is riding by the clearing cable. Thus bowse the clearing cable well up out of the water, and bend to it a hawser, from the hawse, below the turns. Then unbit the cable, veer away upon the hawser, and stick the headmost cable round the other till its end is clear; when, heave in upon the hawser, take in the cable again, and bit it.

How to act when riding hard between the Cables.

Should it come on to blow a gale of wind when a ship is moored, from that quarter which will oblige her to ride equally by each cable, and the hawse is clear, it will be necessary to splice a second cable to the small bower, and to veer away equally upon both cables; but should the hawse be foul, and it is expected that the cables will damage each other, then bend a hawser, below the turns in the hawse, to the small bower, which slip, and let the ship swing to the best bower. When the weather moderates, heave in the end of the ſmall bower, and the ſhip will be moored as before, with a clear hawſe.

To Unmoor a Ship.

Suppoſe the ſhip to be unmoored had her beſt bower to the ebb, in that caſe let her be unmoored upon the ebb tide; but was there any neceſſity for unmooring upon the flood, the ſtream cable muſt be ſpliced to the ſmall bower. To unmoor upon the ebb, when it has made ſtrong, veer away the beſt bower, bring-to and heave in the ſmall bower, and keep veering away the beſt, till the ſmall bower is up and down; then ſtopper the beſt bower. The ſmall bower up, cat the anchor, ſhift the meſſenger, bring-to the beſt bower, and heave in to the whole or half cable ſervice, as may be thought neceſſary; then bit the cable, and fiſh the ſmall bower anchor.

Remark.

Should a ſhip be under the neceſſity of unmooring upon a windward tide with a ſtrong wind, it will be extremely difficult and dangerous to take up the ſternmoſt anchor. In this caſe, if there are no ſhips in the way, the headmoſt anchor may be taken up firſt with ſafety,

ſafety, and the ſternmoſt cable be hove in towards ſlack water.

To preſent a Ship's Side to an Object a-head, when either Wind or Tide-rode.

To preſent a ſhip's ſide to an object a-head when either wind or tide-rode let a hawſer be paſſed from aft, on the ſide that is to be ſhewn to the object, and bent to the headmoſt cable with a rolling hitch. Then by veering away the cable, and holding on the hawſer, the ſhip's ſtern may be brought round to any required degree. The hawſer in this caſe is called a ſpring; and it often happens that a ſpring on each ſide will be neceſſary to preſent either ſide to the object at pleaſure.

CHAP. VI.

Upon getting Under-way.

To caſt a Ship, riding Head to Wind, in a Place where there is no Tide.

To caſt a ſhip, riding head to wind, in a place where there is no tide, let the cable be hove in ſhort; ſend hands up to looſe the top-ſails, which let be ſheeted home and hoiſted; and if it is required to caſt the ſhip upon the ſtarboard tack, brace up the head-yards with the ſtarboard braces, and the after-yards with the larboard braces; then put the helm to port, and ſend the hands to the capſtern, to heave up briſkly the anchor. When the anchor quits the ground, the ſhip, by the aſſiſtance of the helm and ſails, will pay round to port; then hoiſt the jib and fore-ſtay-ſail to help her. The anchor to the bow, fill the head-yards, keep the ſhip her courſe, and trim and make ſail as required.

Remark.

Should the wind blow freſh, it will be proper to cat the anchor before the head-ſails are filled.

To cast a Ship when Tide-rode with the Wind ahead.

To caſt a ſhip when tide-rode with the wind ahead, the ſame practice muſt be followed with the *ſails*, as to caſt a ſhip when wind-rode and no current; but the *helm* muſt be put the contrary way, for now the effect of the *helm* is by the tide's paſſing her, which in the former caſe was by the ſhip's ſtern-way.

Upon getting a Ship Under-way with a leading Wind in a Tide's-way.

If the ſhip to be got under-way has a leading wind, and is in the midſt of a number of veſſels, or in a narrow channel, where it would be difficult to caſt her upon the lee-tide, ſhe ſhould be got under-way before the weather-tide is done. Thus the caſting of the ſhip will be avoided, and ſhe may be ſteered through the channel or fleet with ſafety.

Remark.

Should it blow ſo freſh upon the windward tide as to force the ſhip end-on with her cable, it will be impoſſible to heave it in without ſheering the ſhip over from ſide to ſide, and heaving

in

in briſkly as the ſhip ſlacks the cable; but as this is attended with conſiderable danger, by the ſudden bringing up of the ſhip upon each ſheer, it will be prudent to heave apeak upon the firſt ſetting of the windward-tide, before the ſhip ſwings, to bring the wind aft.

To caſt a Ship from her Anchor, upon a Lee-tide, and back her aſtern clear of Danger.

To caſt a ſhip from her anchor, upon a lee-tide, and back her aſtern clear of danger, upon the ſtarboard-tack, let the cable be hove in apeak; then ſet the three top-ſails braced up with the ſtarboard-braces, and put the helm to ſtarboard, Now heave up the anchor, and as it quits the ground, by the effect of the helm the ſhip will caſt, bringing the wind upon the ſtarboard bow; and immediately ſhe gets ſtern-way, the effect of the helm will be to keep her to the wind.

While the anchor is coming up from the bottom, the ſhip will keep to the wind, and back aſtern extremely well; and by the time the anchor is hove up to the bows, it may be ſuppoſed the ſhip has backed clear of the danger; when, ſhift the helm, run up the jib and fore-ſtay-ſail, and ſhiver the after-ſails. Thus the ſhip will

veer

veer round in little room; when, trim as requi-red.

Remark.

It muſt be remembered, that a ſhip will not readily veer till the anchor is cloſe up to the bow; therefore, when a ſhip is to be got under-way from deep water and a narrow channel, it is beſt to make a ſtern-board from her anchor, which will back her over to the ſhore aſtern by the time the anchor is up, and give her room to veer round.

CHAP. VII.

Upon setting and taking in several Sails in blowing Weather.

To ſet a Main-Sail in a Gale of Wind.

To ſet a main-ſail in a gale of wind, before the ſail is looſed, let the double block of a tackle be made faſt to the weather-clew, and the ſingle block be hooked low down upon the cheſtree, and the fall led aft. Now, man well the

the main-tack, and fall at the ſame time; and when the ſail is looſed, eaſe away the weather-clew-garnet, let go the bunt-lines and leech-lines, bowſe down upon the tackle, and take in the main-tack: the main-tack down, haul aft the ſheet, brace up the yard, and haul the main-bow-line.

REMARK.

A fore-ſail is ſet after the ſame manner as a main-ſail; but as the fore-tacks generally lead double, they are a ſufficient purchaſe without the aid of a tackle to the weather-clew.

To ſet a Top-Sail, in a Gale of Wind.

To ſet a top-ſail, in a gale of wind, a tackle ſhould always be in readineſs to clap on either ſheet, as may be required. Firſt man the lee-ſheet, and the ſail being looſed, eaſe down the bunt-lines and lee clew-line, and haul home the lee-ſheet; then haul home the weather-ſheet, hoiſt the ſail, and brace up as required.

REMARK.

Should the wind be quartering, the lower and top-ſail yards ſhould be braced well to the wind, before the ſail is ſheeted home.

To take in a Courſe, in a Gale of Wind.

To take in a courſe, in a gale of wind, man well the weather-clew-garnet, eaſe off the tack and bow-line, and run it up; then man the lee-clew-garnet, bunt-lines, leech-lines, and weather-brace, and being all ready, eaſe away the ſheet, haul up the clew-garnet, bunt-lines, and leech-lines, and round in the weather-brace, till the yard is pointed to the wind. Now haul taught the truſſes, braces, lifts, and rolling-tackle, and ſend the hands up to furl the ſail.

To take in a Top-Sail, in a Gale of Wind.

Upon taking in a top-ſail, in a gale of wind, nautical men are much divided; ſome approve clewing up to windward firſt, and others to leeward. If the weather-ſide is to be firſt clewed up, the weather-brace muſt be rounded well in, otherwiſe the lee-rigging will be in danger of being carried away by the great preſſure of the lee-yard-arm. With the weather-brace well attended, this certainly is the moſt advantageous way of taking in a top-ſail, for thus the ſail may be taken in without a ſhake; but ſhould the weather-brace give way, recourſe muſt be had to clewing up to leeward firſt. When the ſail is

clewed

clewed up, bowſe taught the rolling-tackle, and ſend the hands up to furl the ſail.

To take in a Jib, when blowing Freſh.

To take in a jib, when blowing freſh, man well the down-haul, let go the haliards, eaſe off the ſheet, and haul down briſkly; and when the ſail is cloſe down, eaſe away the out-haul, and haul the ſail in to the bow-ſprit cap; then let it be ſtowed away in the fore-ſtay-ſail netting.

To haul in a Lower-ſtudding-ſail, blowing Freſh.

To haul in a lower-ſtudding-ſail*, blowing freſh, lead one of the ſheets aft clear, and man it well; then lower away briſkly the outer-haliards, to ſpill the ſail; eaſe off the tack, run in upon the ſheet, and lower away the inner-haliards, as required.

To haul down a Top maſt Studding-ſail, blowing Freſh.

To haul down a top-maſt ſtudding-ſail, blowing freſh, man well the deck-ſheet and down-haul; eaſe off the yard-ſheet, and haul the yard cloſe out to the tack-block; then eaſe away the

* The ſtudding-ſail is ſuppoſed to be ſet on a ſwinging boom.

tack, and haul down both upon the deck-ſheet and down-haul.

To brail up and haul down a Main-top-maſt Stay-ſail, blowing Freſh.

To brail up and haul down a main-top-maſt ſtay-ſail, blowing freſh, man well the lee-brail and down-haul, having a few hands to gather in the ſlack of the weather-brail; then let go the haliards, eaſe off the ſheet, and haul down and brail up as briſkly as poſſible. When the ſail is down, let go the tack, and ſtop the ſail over to the lee fore-rigging.

To brail up a Mizen, blowing Freſh.

To brail up a mizen, blowing freſh, man well the lee-brails, particularly the throat-brails, which ſhould have a whip purchaſe; eaſe off the mizen-ſheet, and brail up briſkly, taking in at the ſame time the ſlack of the weather-brails. After the ſail is hauled up, ſtop its foot by paſſing the gaſket round to leeward, which will ſpill it.

To take in a Top-gallant-ſail, blowing Freſh.

To take in a top-gallant-ſail, blowing freſh, the lee ſheet muſt be ſtarted firſt; for if the weather-

weather-ſheet is firſt eaſed off, the yard will fly fore and aft.

To bend a Courſe.

To bend a courſe, ſtretch the ſail athwart the deck, the ſtarboard-ſide of the ſail to the ſtarboard ſide, the larboard to the larboard ſide; then bend yard-ropes to the earing-cringles, and make faſt the head-earings a few feet up upon the yard-ropes. The bunt lines, leech-lines, clew-garnets, and all the geer bent, make faſt a rope-band to each bunt-line and leech-line leg, that the men may be enabled to catch the head of the ſail from the yard. Now man well the yard-ropes, bunt-lines, leech-lines, and clew-garnets, and run the ſail up to the yard. The ſail aloft, ſend the hands up to bring it to; haul out the weather-earing firſt, then the lee; and if it is a new ſail, ride the head-rope to ſtretch it. The ſail being hauled ſquare out upon the yard, make faſt the rope-bands, keeping the head of the ſail well upon the yard. Should it blow hard, it would be proper to reef the ſail over the head, before it is ſent aloft.

To bend a Top-ſail.

To bend a top-ſail, overhaul the leeches of the ſail, put in the earings, bend the bow line

 legs,

legs, lay out the clews, and open them if neceſſary, and make the ſail up ſnug again; then round down upon the lee-top-ſail-haliards, till the weather fly-block is high enough to bring the ſail up over the guard-iron; when, rack the tye over to the weather-top-maſt-rigging. Now pile the ſail up upon flings, with the lee-ſide uppermoſt; hook on the top-ſail-haliards, and run the top-ſail up into the top; then ſtretch the ſail round the fore part of the top, bend the geer, and make faſt the head earings a few feet up upon the reef-tackle-pendents, with a rope-band or two to each bunt-line leg. The geer being bent, man the reef-tackles, bunt-lines, and clew-lines, and haul out the ſail. Let the hands lay out upon the yard, and haul out the weather-earing firſt; then haul out to leeward, and eaſe off to windward till the ſail is ſquare; when, make faſt the rope-bands, keeping the head of the ſail well up upon the yard.

To unbend a Courſe, in a Gale of Wind.

To unbend a courſe, in a gale of wind, firſt furl the ſail, then caſt off the rope-bands, and make them faſt round the ſail, clear of the gaſkets. When the rope-bands are all off, eaſe off the lee-earing, and lower down the ſail; and when the people upon deck have got hold of the

the lee part of the ſail, eaſe away the weather-earing.

To unbend a Top-ſail, in a Gale of Wind.

To unbend a top-ſail in a gale of wind, firſt caſt off the points of the reefs, keeping faſt the earings; then furl the ſail, and caſt off the rope-bands, which make faſt round the ſail, clear of the gaſkets. After this caſt off the lee-earings, and haul the lee ſide of the ſail into the top; then haul in the weather ſide. Now unbend the reef-tackle pendents, bunt-lines, and bow-lines; bight the ſail ſnugly up together; and ſend it down by the clew-lines to windward or leeward, as moſt convenient.

CHAP. VIII.

Respecting Cables, Nippers, and Stoppers.

Upon coiling Cables.

All cables ſhould be coiled the way they bit, or the way they run round the windlas, and their tiers ſhould be on the ſide oppoſite to that on which they lead. The beſt bower, which is moſtly the working cable, ſhould lead foremoſt up the hatchway; then the ſmall bower; and abaft all, the ſheet, which being the leaſt wanted can be triced ſnug round the after part of the hatchway, out of the way. Should your new cables come immediately from the rope-walk, let them be coiled down into the craft that is to bring them on board, the ſame way they are to be coiled on board.

A cable generally kinks from more turns being forced into it by the coiling than it naturally had, and the only way to get rid of theſe kinks, is to coil the cable acroſs the hatchway from ſide to ſide, in large fakes, with the ſun; then take the upper end through the coil, and coil the cable down in the tier the way required.

By

By this means, as many turns will be taken out of the cable as there are fakes coiled round the hatchway.

It ſhould be a rule in coiling cables never to lay out near the hatchway, but to keep that part of the tier as low as poſſible, that the bends may have ſufficient room to upſet.

Were all ſtore cables firſt coiled down from the rope-walk againſt the ſun, they would be better adapted to coil on either ſide of a ſhip; for a cable coiled againſt the ſun will more eaſily reverſe, and have leſs kinks in it than a cable coiled with the ſun.

On ſplicing Cables.

The ſnuggeſt and beſt method of ſplicing a cable is to put the ends in twice each way; then to pick out the ſtrands, and worm part of them round the cable, and taper away the reſt, which let be ſnugly marled down. After this let there be clapped on a good throat, and two end-ſeizings of ſix thread rattling.

The ſtrands of the ſmall bower and ſtream cable had better be pointed, that theſe cables may be more briſkly ſpliced in caſe of neceſſity.

Upon ſerving Cables.

Cables ſhould be ſerved againſt the lay. The moſt expeditious way of clapping on rounding is with a top, when there is room to work it, otherwiſe, recourſe muſt be had to beating it on with mallets. Be careful to let the ſervice be ſtopped with ſpun-yarn every ſix or eight turns.

Mooring ſervices are generally clapped on about fifteen fathoms from the end, or ſplice of the cable; and large veſſels ſhould have about twelve or fourteen fathoms of ſervice, half of it rounding and plat, and the reſt keeling. Upon the working cable, there ſhould be a ſhort ſervice of eight or ten fathoms at the half cable.

Mats, made the width of the round of the cable, and about three fathoms long, are very convenient to have at hand, to lace on the cable with expedition in caſes of neceſſity.

Of an approved Dog-ſtopper.

An approved form for a dog-ſtopper is to have it made with a large eye, that it may be thrown over the bit-head, and ſhifted over from ſide to ſide at pleaſure.

Of an approved Bit-ſtopper.

An approved form for a bit-ſtopper is to have it about four or five fathoms long, and tailed out, nipper faſhion, at one end, and knotted at the other: let this ſtopper be rove through the hole in the knee before the bits. To paſs it, let it be led aft, inſide and over the cable, then under the bit-end, outſide the cable, and worm its end round the cable before the bits, as repreſented by plate 2, figure 13. Now, to ſtopper the cable, haul taught the worming, and by the cable's drawing forward it will taughten the ſtopper, and bind the cable ſo cloſe to the bits as effectually to bring the ſhip up. From the nature of this ſtopper it is not likely to jamb, therefore is extremely well calculated for bringing a ſhip up with eaſe, as by ſlacking or hauling taught the worming, the cable may be ſuffered to run out or be checked at pleaſure.

In heaving up in a ſea, when by a ſudden pitch of the ſhip the meſſenger or nippers give way, this kind of ſtopper will be found extremely ſerviceable, for upon theſe occaſions, it may be always paſſed ready, and the bight triced up abaft the bits with a rope-yarn, clear of the cable, as repreſented by plate 2, figure 14.

REMARK.

Stoppers from the wings of the tiers are extremely ſerviceable; but ſtoppers from the maſt, below the combings, are of little ſervice, unleſs they be made long enough to clap on above the combings.

Upon Ring-Ropes.

Ring-ropes are better ſingle than double; for when ſingle they are paſſed with leſs confuſion of turns. To paſs a ſingle ring-rope, and have it in readineſs to check upon veering away cable, take three ſlack turns through the ring and round the cable, one before the other, and let a hand hold up the parts fair; then take as many ſlack turns of worming round the cable, before the ring, which let be held up fair by another hand, giving ſufficient room for the cable to paſs through. Now, when it is neceſſary to check the cable, haul taught the worming, and by the cable's going out it will preſently draw thoſe turns taught which were taken through the ring, and bind the cable ſo cloſe to the ring, as to prove an excellent ſtopper.

Upon Nippers, and the Manner of clapping on a Racking Nipper.

The uſual method of clapping on a nipper, with a round turn round the meſſenger and another round the cable, is an exceeding good one, and very ſuitable to quick heaving; but when a ſtrain is to be hove, and the cable is muddy, the nippers clapped on after this method will not bite, and recourſe is generally had to hitching the meſſenger, a very bad practice, which juſtly deſerves to be reprobated, as in the nip it materially damages both cable and meſſenger. In this caſe throw ſand or aſhes upon the cable, and take a long dry nipper, which middle and paſs one half aft, racking it in and out round the cable and meſſenger; then worm its end round the meſſenger only. After this, paſs the other half in the ſame manner forward, but worm its end round the cable only, and let a hand hold on each end of the nipper. Now the advantage of this method is, that by the cable's drawing forward, and the meſſenger aft, the nipper will be drawn ſo taught as effectually to hold the cable till ſomething gives way: another advantage is, it can never jamb, for both ends are clear for taking off.

For quick heaving alſo, if nippers without knots are clapped on, as repreſented by figure 15, plate 2, where the nipper is taken once round the meſſenger and once round the cable, its foremoſt end being wormed round the cable, and the after-end round the meſſenger, it will ſave the cutting of many nippers.

CHAP. IX.

Upon Purchases, and Friction.

It is extremely neceſſary that every ſeaman ſhould be ſo far acquainted with the mechanical powers, as to be able to calculate the force of thoſe purchaſes he is continually applying.

Upon the Crow, Handſpec, and Capſtern-bar.

The crow, handſpec and capſtern-bar are all levers of the ſame kind, differing only in their power by the difference of their lengths from each reſpective prop, or fulcrum.

 Let

Let us ſuppoſe AB, plate 1, fig. 13, to be a handſpec or crow eleven feet long, and for the purpoſe of priſing up a weight is reſted upon the prop C at one foot from A, and the weight applied to the end A being ten hundred weight, it is required to know what power muſt be applied to the end of the handſpec B to raiſe the weight at A. For this purpoſe, multiply the weight applied at A by the diſtance AC, and it will give the momentum of the weight. Now it is clear that the momentum on the other ſide of the prop muſt be made equal to this, before the weight at A can even be balanced, therefore let the diſtance CB be multiplied by ſome power that will make the momentum at B equal to the momentum at A, then that power will be the quantity neceſſary to raiſe the weight at A. For inſtance, in the preſent caſe, the weight at A of ten, multiplied by the diſtance AC of one, gives ten for the momentum at A; and if the diſtance CB of ten be multiplied by one it will give ten for the momentum at B; therefore one hundred muſt be the power applied at B to balance the weight at A; and to raiſe it higher, a little more power muſt be added to overcome the friction. Again, let us ſuppoſe AB to be a capſtern-bar, and that the circle repreſents the barrel of a capſtern turning on the centre C, which in this caſe is the prop. Now, if it is required

required to know what power at the end of the bar B will purchafe the weight at A, we muft apply the fame reafoning as in the former cafe. For inftance, let the weight be multiplied by half the diameter of the barrel, to give the momentum of the weight, which fame momentum muft be gained on the other fide of the centre, by multiplying the diftance BC by fome power which will make the momentum on this fide equal to the momentum on the other, which will be the power required.

Therefore, the power of a capftern or windlas is nothing more than the united powers of a number of levers; but it muft be remembered, that as capfterns turn round upon very large fpindles, they are fubject to a confiderable degree of friction. This certainty may be remedied, either by decreafing the diameter of the fpindle, or by fixing friction-rollers in the partners round the fpindle, as reprefented by figure 16, plate 2, where A reprefents a fection of the fpindle, and the fmaller circles the friction-rollers. But after taking off the extreme friction of a capftern, it will be found neceffary to increafe the number of paul-catches, to prevent the people being thrown from the bars when the fhip pitches.

Upon

Upon a Whip-Purchaſe.

The better to conceive the power of a ſimple whip-purchaſe, let us aſk the queſtion—if a perſon was to haul a hundred weight into a ſhip's top by this means, which is repreſented by fig. 17, plate 2, what part of it would reſt upon his hands? Let the block compoſing the whip be made faſt to the weight, and let the ſtanding part of the whip-fall be made faſt to the top rim. Now, let the perſon in the top weigh the weight off the deck, and then let him conſider what part of it reſts upon his hands:—the weight hangs by two ropes which are equally taught, conſequently each rope bears the ſame quantity of the weight, but together both ropes bear only a hundred weight; therefore each rope ſeparately muſt bear fifty; and as the perſon holds one of the ropes, fifty weight muſt be the quantity reſting upon his hands.

Upon a Tackle.

A tackle is a convenient kind of purchaſe, but ſubject to much friction. Its power will be, friction not conſidered, as the number of parts of the fall that are applied to ſuſtain the weight. If the tackle conſiſts of a double and a ſingle block, there will be four parts of the fall; and if the weight to be hoiſted up be hung to the double block, it will reſt upon four ropes, which are each equally ſtretched; therefore each muſt bear the ſame part of the weight. Now let us ſuppoſe the weight hung to the double block to be four hundred, then one hundred applied to the hauling part of the fall will ſuſpend it; and if as much more power be applied as will overcome the friction, it will purchaſe the weight: but had the weight been hooked on to the ſingle block, it would have reſted by three ropes only, each of which would bear a third; therefore a third of the weight being applied to the hoiſting part of the fall, would ſuſpend the weight when hooked to the ſingle block; and as much more power being applied as would overcome the friction of the tackle, would purchaſe the weight.

Of the greateſt Purchaſe to be gained by Blocks.

The greateſt purchaſe that can be gained by blocks, is by having a continued ſeries of whips, that is, the continuation of fixing one whip upon another whip-fall. By this means, two ſingle blocks will afford the ſame purchaſe as a tackle having a double and ſingle block, and with conſiderably leſs friction. This kind of purchaſe ſhould certainly be uſed whenever the length of the hoiſt will admit of it. To top-ſail

and

and top-gallant-yards that hoiſt up with a ſingle tye, there will be ſufficient room to apply this purchaſe as haliards, which will overhaul with great facility.

Upon the Purchaſe gained by Swigging off.

What is called ſwigging off, that is, pulling at right angles to a rope, is at firſt a very great power, but it decreaſes as the rope is pulled out of the ſtraight line. This purchaſe depends upon the reſolution of forces, and its power is as the ſine of half the angle formed by the rope; that is, as half the angle ACB, fig. 14, plate 1.

A purchaſe upon this principle may be conveniently applied to ſeveral purpoſes, Thus, in the place of yard-tackles, let the blocks A and B, fig. 14, be fixed to the lower yard-arms, and through theſe blocks let there be rove a pendent with a hook at each end: the pendent ſhould be long enough to reach the water on the oppoſite ſide, when one of the hooks are up at the yard-arm; for inſtance, with one hook up at B, the pendent ſhould paſs ſtraight along the yard to A, and from A to the ſurface of the water. On the bight of the pendent let there be a fiddle-block, the pendent leading through the upper ſheave, and a whip-purchaſe through the lower one, coming down before the maſt amidſhips. Now,

 when

when any thing is hoifting up by this purchafe, for inftance, the boat D, it will have the appearance as reprefented in the figure: if it be required to hoift in on the oppofite fide, overhaul down the hook B. It will be proper to have a tricing-line, to trice up the block C when the purchafe is not wanted.

For an example of a fecond application of this purchafe, let us fuppofe that a boat's crew were about to haul their boat afhore, but fhould find their own power infufficient, and that they had no tackle. In this cafe, let them drive down a ftake well up from the water, and a fecond clofe down to the water's edge; then let the boat's painter be made faft to the upper ftake ftraight from the boat, and led round the lower one; now, by fwigging off upon the painter midway between the ftakes, the people will pull with much greater power; and if the power be yet infufficient, it is only moving the ftakes further afunder.

Upon Dead-eyes, Hearts, and Thimbles.

The power gained by dead-eyes, hearts, and thimbles, is as the number of parts of the laniard that is rove through them; but if the laniard be not well greafed, their power will be moftly, if not entirely, counterbalanced by the

friction

friction they are subject to. This being the case, they are never applied as purchases, but merely for the better keeping the quantity gained of any shroud or stay when set up. For if a shroud or stay were set up without their application, the quantity lost upon making fast would slacken the shroud by the same quantity; but when a dead-eye and laniard are fixed to the shroud, should even *six* inches of the laniard be lost upon making fast, the shroud would be slackened only *one* inch; for there are six parts of the laniard to the shroud, and as the shroud is equally held by each part, it can only be slackened by the quantity that the parts of the laniard are lengthened.

A general Rule for calculating the Power of Purchases.

A general proportion for calculating the power of any particular engine is, as the weight is to its space passed through, so the space passed through by the power is to the power: thus, suppose that a weight when hoisting up by a tackle should pass through one foot for every three feet hoist of the fall, then the power will be as one to three; and if the end of a handspec should pass through ten inches to prize up a weight one, the power will be as one to ten.

A Mechanical Increase of Power is Loss of Time.

To ſhew that a mechanical increaſe of power is a loſs of time, let us ſuppoſe that a perſon had to haul a hundred weight into a ſhip's top by a ſingle rope, which is no purchaſe, then the length of the rope to paſs through his hand would be equal to the height of the top from the deck; but if this perſon had to haul up the hundred weight by a whip-purchaſe, as repreſented by fig. 17, plate 2, then the length of the rope to paſs through his hand would be equal to twice the height of the top from the deck; and admitting that the rope paſſed through the perſon's hands as faſt in one caſe as the other, the weight would come up by the ſingle rope in half the time that it would by the whip; which proves that an increaſe of power is loſs of time.

Upon Friction.

The friction of moſt mechanical engines is ſo extremely compounded, as to make it difficult to ſay what is the preciſe quantity. Thoſe metals will run the eaſieſt together whoſe ſurfaces leaſt adhere to each other; and it is ſuppoſed that the difference between the friction of two bodies, compoſed of ſimilar ſubſtances, and moving

moving upon the ſame ſurface at the ſame rate, will be, *as the difference of the ſurface preſſed upon, and the preſſure*; alſo, that the friction of the ſame body increaſes as *the ſquares of its velocity*: therefore, the pins of blocks and ſpindles of every kind ſhould be as ſmall as ſafety will allow; and ſheaves ſhould be large, and falls be ſlack laid, otherwiſe much of the power will be loſt in obliging the fall to bend to the ſheave. All fixed blocks are only for the convenience of turning the direction of a fall; they add nothing to the power of the purchaſe, but on the contrary deſtroy ſo much as is neceſſary to overcome their friction, therefore theſe blocks are to be avoided as much as poſſible.

CHAP. X.

Upon Leaks.

Water presses as the square roots of its altitude, that is, suppose equal holes be made in the bottom of a vessel at one foot, four feet, nine feet, and sixteen feet beneath the surface of the water, the water will rush in at these holes with a velocity equal to the square roots of their respective depths: for instance, at the four feet hole it will rush in twice as fast as at the one; at the nine feet, three times as fast; and at the sixteen feet, four times as fast; which is the law it will follow, provided the water be pumped out of the vessel as fast as it comes in. But if the water is suffered to rise in the vessel and cover any of the holes, the covered holes will then run with the same velocity, regardless of their depths, which velocity will be as the square root of the difference of the level between the water within and without the vessel; for example, let it be presumed, that the hole at sixteen feet was quite at the bottom of the vessel, and that the water had risen in her twelve feet, then as its surface is even with the four feet hole, the two covered holes

holes will run with the velocity only of the four feet hole, ſince four feet is the difference between the level of the water within and without the veſſel.

From the foregoing reaſoning it appears, that if a ſhip ſprings a leak under her bottom, though the water ſhould increaſe upon the pumps at firſt, yet after the water has riſen a certain height above the leak, the pumps will then be enabled to prevent it from riſing higher.

Let us now conſider how a leak in a veſſel's bow and ſtern will be effected by her motion through the water. Let the leaks to be conſidered be of equal ſize, and nine feet deep, then the water will ruſh in at each leak with a velocity that may be expreſſed by three, while the ſhip is without motion and in ſtill water; but if the veſſel be given head-way, the water will increaſe running in at the bow by the head-way, and decreaſe at the ſtern in the ſame proportion: and ſhould ſhe ſail ſo faſt as to double the running in of the water at the bow, the leak at the ſtern will become nothing. Thus it appears, that a leak at the bow is more dangerous than a leak at the ſtern. A leak alſo on the lee-ſide muſt be more dangerous than a leak on the weather ſide; firſt, by its being forced deeper under water, and ſecondly, increaſed by the lee-way.

The

The following rules, founded upon the fore-going reaſoning, may lead to a diſcovery of the ſituation of a ſingle leak. Firſt, if the ſhip increaſes making water as ſhe ſails, the leak is in the bow; but, on the contrary, if ſhe decreaſes making water as ſhe ſails, the leak is in the the ſtern; and, ſecondly, when ſailing before the wind, if the ſhip makes neither more nor leſs water, the leak is on either ſide, which ſide may be diſcovered by hauling upon a wind; then if the ſhip makes more water it is on the lee-ſide, otherwiſe it is on the weather-ſide. It has been aſſerted, that by following round a leaky veſſel in a calm with a pole, keeping one end applied to the ear, and the other to the veſſel's bottom, that, ſhould the end of the pole chance to paſs near the leak, a rumbling noiſe will be heard coming up the pole, and thus point out its place.

Should a leak be in the bow, it certainly may, in a great meaſure, be remedied at ſea by ſpreading a tarred ſail with oakum ſewed to it acroſs the bows, and confining it to by ropes; then the motion of the veſſel forward will preſs the ſail cloſe to the bow, and prevent the water from entering the leak. To a leak in any other part, the ſail may not prove ſo effectual a remedy.

For preventing the water from entering the ſeams between wind and water, which ſome veſ-

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ſels by their working are continually emptying of the oakum, it will be better to nail double canvaſs, or leather with oakum beneath it along the ſeams, than to cover them with lead, which is ſubject to be broken.

It has frequently happened that ſhips have been left by their crews, becauſe the water gained upon the pumps, and that the ſame veſſels have been met with afterwards and brought into port. If a ſhip's cargo, when ſoaked in water, would of itſelf float, there would be no danger of the ſhip's ſinking, for as the water roſe in the hold, the cargo immerſed would become of no weight, but, on the contrary, would act as a ſupport to the veſſel by as much as it is lighter than water. Thus, a ſhip loaded with timber, though the water ſhould be up to her decks, would not ſink; and, probably, a ſhip loaded with ſpirits would not ſink lower, after the whole cargo was immerſed. Therefore, a commander, knowing that his cargo when ſoaked in water will float, ſhould be very backward in deſerting his veſſel, for he may yet find more ſafety on board her than in open boats.

The danger to be expected on board a veſſel in this ſituation is, ſhe may upſet; for as the cargo immerſed bears leſs upon the veſſel, her ſtability muſt proportionably decreaſe; and ſhould the immerſed part of the cargo, beneath

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the centre of motion, confift of articles of the fame weight, or fpecifically lighter than water, without iron or leaden-ballaft in her bottom to keep her erect, fhe muft inevitably turn bottom up. The criterion to judge of a veffel's ftability in this fituation is her roll, which becomes greater and flower as her ftability leffens. Upon occafions of this kind, I would recommend the getting all heavy materials of every defcription, as lead, guns, and iron, as low into the hold as poffible, and to throw overboard every article above the orlop deck, except the neceffary conveniencies of life; alfo to ftancheon and lafh the decks together round the beams, that they may fuftain each other, and prevent their being blown up; and to bring up all empty cafks, and fecure them down to the orlop-deck beams. Thus prepared, the fhip may have fufficient ftability while in the act of finking, and upon the empty cafks being immerfed, (fince they are above the centre of motion) they will not only tend to float her, but add to her ftability. After the cafks are immerfed, every attempt is to be made to prevent the water from rifing higher; if this cannot be effected, the veffel muft be quitted.

CHAP.

CHAP. XI.

Upon Stowage.

It has been before remarked, that the eaſineſs of a veſſel depends upon the ſituation of her centre of gravity. Should the cargo be heavy, and its centre of gravity be low, her ſtability will be ſo great as to return the veſſel to her erect poſition with ſuch violence, as to endanger the maſts. Probably, a tolerable point for placing the centre of gravity of a veſſel's cargo, if ſhe is to be deeply laden, may be about half way between the kelſon and centre of motion, which will be about a quarter of her beam up the hold. But if ſhe is not to be deeply laden, the centre of gravity muſt be placed lower, otherwiſe the veſſel will not have ſufficient ſtability.

It is neceſſary likewiſe, for the purpoſe of relieving the pitching, and that the extremes of a veſſel may not be loaded beyond their capacity to bear, that the weight be collected towards the centre of the veſſel, between the main-maſt and fore-hatchway, and that the extremes be loaded with the lighteſt articles: this is a circumſtance too little attended to, particularly in Eaſt-India-

men,

men, where the water and provifions are ftowed clofe forward.

If the cargo is regular, *i. e.* confifts uniformly of the fame goods, let it be ftowed fore and aft upon a level, obferving not to fill up the breakages, either forward or aft, with heavy articles.

If the cargo fhould be irregular, the officer's judgment muft be employed to diftribute it in fuch a manner over the veffel, that it may prefs upon the different parts of her, in proportion to their capacity to bear.

CHAP. XII.

Miscellaneous Articles.

Upon the Polarity of a Sewing Needle.

There are few fewing needles but have a polarity, and when floated in water will tend to the magnetic meridian, the point of the needle going to the fouth. This is a neceffary circumſtance for ſeamen to be acquainted with, for ſhould they be ſo unfortunate as to quit their veſſels without a compaſs, by the aid of a common ſewing needle, which ſeamen are ſeldom without, they are ſupplied with a tolerable ſubſtitute.

If a needle ſhould be found without much polarity, hold the point towards the ſouth, and rub it ſtrongly from the middle towards the point with the back of a knife, and it will excite a very ſtrong polarity.

A dry needle gently dropt into the water will ſwim of itſelf, but immediately on the upper part becoming wet it will ſink.

If ſeveral rubbed needles be ſtuck together with their points one way through a very ſmall piece of cork, they will move with a much quicker motion to the meridian than either of the needles ſingly.

Upon ſmoothing the Surface of the Sea, for the Purpoſe of Landing a Boat.

A quantity of oil being diſtributed over the ſurface of the ſea will prevent it from breaking, and greatly contribute to lower the ſwell. Was a boat before attempting to land upon a lee-ſhore, to bring up, and pour a quantity of oil upon

upon the water, till it ſpread itſelf, and ſmoothed the water between her and the ſhore, ſhe might then venture to weigh, and have conſiderable chance of reaching the ſhore with ſafety.

To preſerve a Boat from Foundering in a Gale of Wind.

To preſerve a boat from foundering in blowing weather, it will be neceſſary to have with her a ſmall ſpar, as a top-gallant-yard. Let this ſpar be equally ſpanned, and to the middle of it be made faſt three or four fathoms of rope, with the boat's grapnel at the end. Now ſhould it come on to blow hard, and the boat be in danger of ſhipping a ſea, bend the boat's cable to the middle of the ſpan, and let her ride by the ſpar, which will be prevented from heaving on board the boat by the grapnel. Thus, by the ſpar's extending acroſs the bows of the boat, it will prevent the ſea from breaking over her.

It will be neceſſary to ride the boat very cloſe to the ſpar, and when the ſpar is not wanted, (ſhould it be too large to take on board the boat), it may be towed end-on aſtern of her.

On the Manner of acting upon Accidents happening to the Helm; and a Description of a temporary Rudder.

Should a tiller break in a rudder-head, the rudder muſt immediately be chocked that the ſtump may be taken out and another tiller fitted, which ſhould always be placed in readineſs together with the chock, in caſe they ſhould be wanted. While the rudder is uſeleſs, the ſhip muſt be hove-to till it is repaired; or ſome contrivance prepared to ſupply its place. The moſt ready application for ſupplying the place of a rudder is the following, till a better contrivance can be got ready. To a long ſtout boom, laſh ſeveral pieces of junk and ſpars, about three fathom long, one beneath the other, and ſtiffen them acroſs by ſeveral pieces of plank; to the bottom of this, faſten ſome pigs of lead to ſink it, and let it be fixed to the ſtern, as repreſented by figure 18, plate 2, the end of the boom A being faſtened to the ſtern-poſt, and the outer end ſupported by a ſtrong topping-lift from the taffarel. On each ſide of this temporary rudder are to be fixed guys from the ſpan D, to haul it over to either ſide; the lower legs of the ſpan muſt be ſhorter than the upper, that it may haul over with an obliquity which gives it a tendency to dive, otherwiſe it might riſe out of the water. The guys are to be led through ſtout blocks, laſhed to booms rigged out upon each quarter, and to each is to be fixed a tackle, the falls of which are to be led under the barrel of the wheel, and ſeveral turns about it, and are then to be ſpliced taught together.

The leading of the falls under the wheel gives a great advantage; as the ſhip is ſteered by moving the wheel round the ſame way as if ſteering with a rudder. This contrivance will anſwer tolerably well, till the following rudder can be prepared, the invention of Captain Edward Packenham of the Royal Navy.

1, Fig. 15, plate 1, is a topmaſt inverted, which forms the main piece of the rudder, its heel becoming the head, which is ſo ſecured by the anchor hoops, 9, that the fid-hole may be increaſed to receive a tiller. This main piece is pointed through a topmaſt-cap, which is enlarged, that the main piece may turn freely in it. Fig. 17, is a repreſentation of the cap with its ſquare part cut out to fit the ſtern-poſt, having fixed to it the top-chains. 2, Fig. 15, is the inner half of a jib-boom; 3, the outer half; 4, a fiſh, all of which are firmly bolted to the main piece, and planked over, as 6 6 6, &c.—10, 10, 10, are pigs of ballaſt to ſink the heel of the

rudder;

rudder; 5, a rope to ſuſpend the rudder. Fig. 16, anchor-ſtocks cut out to receive the round part of the main piece of the rudder.—The whole machine being prepared, let it be got under the ſtern, and its head be hove up through the counter to a neceſſary height. Then, to each of the top-chains, bend the end of a hawſer from the hawſe-holes;—bear the rudder amidſhips, and heave well taught the hawſers, which will firmly ſecure the cap to the ſtern-poſt. This done, let the anchor-ſtocks be ſecured round the rudder-head to the deck it comes through, that they may act as an upper gudgeon for the rudder to turn in;—the tiller, &c. being fixed, the veſſel is now fitted with a rudder, nearly as perfect as her former.

To Steer a Veſſel which has loſt her Rudder, by another Veſſel.

To ſteer a veſſel which has loſt her rudder, by another, let the *diſabled veſſel* take the other in tow, and make ſail. To the tow-rope, at a few fathoms abaft the ſtern of the leading veſſel, let ſteering-ropes be made faſt, coming through blocks upon booms rigged out over each quarter and about the barrel of the wheel, as explained in the foregoing article. By turning the wheel round, the veſſel aſtern is brought to tow a ſtrain

 upon

upon either quarter of the leading veſſel, forming a ſort of temporary rudder by which ſhe may be ſteered as required.

Let it be remembered that the veſſel aſtern muſt ſteer the ſame courſe as the leading veſſel; and when it is required to tack, the veſſel aſtern ſhould be ſheered to leeward, and not put in ſtays till the leading veſſel has come up three or four points in the wind.

Upon recovering a Veſſel upright, without cutting away her Maſts.

It often happens that by a ſudden ſquall of wind a veſſel is thrown over upon her beam ends, without a proſpect of recovering her erect while ſhe remains upon the ſame tack, therefore attempts are made to veer her; but as the rudder lies along the ſurface of the water it becomes uſeleſs, and as the ſails are either blown from the yards, or become unmanageable, recourſe is had to cutting away the main-maſt and mizen-maſt, that the ſhip may veer under the fore-maſt:—a moſt deſperate expedient, particularly if the ſhip is far diſtant from port! Upon this occaſion, that the ſhip may be recovered upright without cutting away her maſts, let the following method be practiſed. If ſhe is in a ſituation where ſhe can be brought to an anchor,

 let

let go her lee-anchor, which will ſwing her wind-rode, and relieve her from the ſtrength of the wind; but ſhould ſhe, in this dreadful ſituation, be at ſea, let the end of a hawſer be handed over the lee-quarter and round to windward, and to it be bent any of the ſmall anchors,—half-butts,—ſpanned gratings,—or any thing at hand that will act as ſtopwaters; then throw the whole overboard, and veer away upon the hawſer to a neceſſary quantity, when make it faſt. Now by the ſhip's drifting from this tow, it will pull with ſuch power upon her ſtern as to veer her, and bring the wind upon the oppoſite ſide.

To clear Veſſels that have run aboard each other.

It frequently happens that two veſſels which have run aboard each other are ſo completely bound together, either by the tide, or the wind and ſea, that it is out of the power of the helm and ſails to force them aſunder. On this occaſion, if the veſſels are in a ſituation where they can come to an anchor, let one of them bring up and the other will drift clear of her: but ſhould they be at ſea, let the weathermoſt veſſel be brought up by the floating anchor, page 44, or by a tow from her bow, as mentioned in the foregoing article.

Upon Steering a Ship which has lost her Fore-mast.

A ſhip that has loſt her fore-maſt can only be ſteered with the wind aft, and that not without being ſubject to broach-to. Directly a ſhip in this ſituation receives the wind ſideways, all the lateral preſſure of her ſails will be abaft the centre of gravity, which her rudder not being able to counteract, muſt oblige her to approach the wind; but could the power of the rudder be increaſed to any required degree, a ſhip could be ſteered with the wind beaming, notwithſtanding the loſs of her fore-maſt. To do which, let the following method be practiſed:—veer aſtern 20 or 30 fathom of cable, which, if the ſhip is in ſhoal water, ſhould be buoyed up. Then rig out a boom with a ſtout guy upon each quarter, and let the guys be bent to the cable a few fathoms abaft the ſtern. While the ſhip is ſailing before the wind, let the cable be guyed to tow amidſhips of the ſtern, and it will prevent her from broaching-to; but while the wind blows ſideways upon the ſhip let it be guyed out to the lee-boom, which will greatly aſſiſt the weather-helm.

Upon hauling a Veſſel off a ſteep Shore in a Calm.

It has often happened that veſſels have been driven, in calm weather, upon a ſteep and dangerous ſhore which has denied anchorage, but might have been ſaved by exertion and judgment. Caſes of this kind require great animation on the part of the officers. All boats muſt be immediately hoiſted out to tow the ſhip, if poſſible, from her perilous ſituation. In the mean time let ſtop-waters be got ready to run out from the veſſel, and haul her off, ſhould towing prove ineffectual. Large butts cut in halves and ſlung, ſerve excellently for this purpoſe, and are uſed with advantage in the following manner. Let each boat take ſeveral of theſe half butts, and row away from the veſſel with a coil or two of ſmall rope: when the rope is out, ſpan the boat from head to ſtern, and tow the half butts from the oppoſite gunwale of the boat, at ſeveral fathoms diſtance; thus, when the rope is hauled in on board the veſſel, the boat will hang athwart, and, together with the half butts, muſt oppoſe conſiderable reſiſtance. To draw the veſſel ahead, let the boats employed row out alternately, that one line may be in readineſs to haul upon, when the other is all on board. Should it remain calm, or ſhould

 there

there be a light air of wind opposed to the vessel's course, the sails must be furled.

To prevent rolling away the Masts upon coming out of Port, with new *Rigging, immediately into a high Sea.*

Vessels have frequently rolled away their masts from coming suddenly out of port into a high sea with *new* rigging. On an occasion of this kind, if one of the bower anchors be let go, and a necessary quantity of cable wore away, it will bring the ship's bow to the sea, when she will roll less, and afford an opportunity for securing the masts. Lieutenant Thomas Owen, of the Royal Navy, informed me that he saved the masts of a vessel, thus circumstanced, by the above means.

A Mode of fitting Top-gallant-fids, that they may be taken out with Ease.

It frequently happens in gales of wind, from the inclination of the ship, and the strength of the wind, that a top-gallant-mast is so completely bound, between the cap and the trestletrees, as to render it impossible to sway it up to take out the fid; to remove this inconvenience is the intention of the following contrivance. Let B, plate

plate 2, figure 19, be a ſtout braſs ſheave, or roller, at the upper part of a top-gallant-fid hole for the maſt to reſt upon; CD a fid of iron, circular at the upper ſide, and going off to a point at C; A, A the treſtletrees; 2, 2, plates of iron for the fid to reſt upon; D, a hole to laſh the fid to the heel of the maſt to prevent its working out. Upon conſidering this plan of fidding a maſt, it muſt appear clear, that by a ſlight blow of a maul at the end of C, the fid will be forced out, though the maſt ſhould not be lifted.

Upon diminiſhing the Steeving of Bowſprits.

As every poſition of the rudder, except a middle one, takes from the ſpeed of the veſſel, it ſhould be preſerved as much amidſhips as poſſible. Almoſt every ſhip under full ſail, with a ſide-wind, carries a weather-helm; to counteract which, it is recommended to lower the ſteeving of the bowſprit to an angle of 5, or 10 degrees with the keel, and to increaſe the jib-boom in ſtoutneſs, that a large jib of ſtrong canvas may be carried, in moſt weathers. With the bowſprit lowered, it will be better without a ſpritſail-yard; and let the jib-boom be ſecured from the cat-heads and ſtem, by a ſtanding and travel-

travelling guy on each ſide, and a ſtanding and travelling martingal.

Upon equalizing the Sails, Yards, and Maſts, of the Fore and Main-maſts.

A conſiderable convenience would ariſe from having the fore and main-top-ſails of the ſame ſize, alſo the fore and main-top-gallant-ſails, and the maſts and yards appertaining to them, as it frequently happens that accidents fall more to the lot of one maſt than the other. The main-maſt I would ſtill continue taunter than the fore-maſt, that the ſpaces beneath the top-ſails and top-gallant-ſails of the main-maſt may be above the ſame ſpaces upon the fore-maſt, to prevent the loſing any wind, and that the lower yards may not lock together in going about.

Upon Compaſſes, and Binacles.

When a compaſs is not in uſe its card ſhould be taken off the point. All compaſs-cards that are unhung ſhould be placed together in pairs, the North point of one to the South point of the other, wrapped up in dry brown paper, and ſeparated a ſmall diſtance from any other pair:

if they be thus packed, their needles will increafe in magnetical virtue.

Great care fhould be taken that the fides of all the binacles are placed in a line parallel to the longitudinal axis of the veffel, thus all the binacles will be parallel to each other; and as the lines within a compafs bowl are parallel to the fides of its box, by placing either fide of the compafs box to either fide of the binacle, the line in the compafs bowl muft ftand parallel to the longitudinal axis of the veffel. For want of paying proper attention to fetting the compaffes parallel to each other, they are frequently faid to differ, when upon a nicer examination out of the binacle they are found to agree.

Again, all binacles fhould be either pegged together, or nailed with *brafs* nails.

CHAP.

CHAP. XIII.

Upon Manœuvring a Fleet.

Of the Command and Division of Fleets.

The whole fleet is under the general direction of one commanding officer; but for the ſake of diſcipline it is divided into three grand diviſions of equal force, denominated the centre, van, and rear diviſions. The centre is more particularly commanded by the ſuperior officer of the fleet, the van by the ſecond officer in command, and the rear by the third officer.

Beſides theſe diviſion, for particular ſervices it is found neceſſary to have ſquadrons, compoſed of ſhips having particular qualities.

The ſhips of the centre diviſions are known by carrying their diſtinguiſhing-vanes at the main, the van diviſion by carrying their vanes at the fore, and the rear diviſion by carrying their vanes at the mizen; each commanding officer being diſtinguiſhed by his flag at the main,

main, fore, or mizen, according to the rank he bears.

Of the Order of Sailing.

The order of ſailing is, that particular order which a fleet preſerves for the ſake of regularity when purſuing its proper courſe. The diſpoſition of this order reſts with the commander of the fleet. It ſhould be ſo contrived that the ſhips may not moleſt each other, and yet be capable of aſſuming the order of battle and retreat with facility. We ſhall conſider the order of ſailing throughout this chapter as compoſed of three lines, the ſhips ſailing abreaſt of each other, becauſe lines can more readily aſſume the order either of battle or retreat.

Of the Order of Battle.

A fleet is in the order of battle when the ſhips are one ahead of the other, in a line ſix points from the wind, either upon the ſtarboard or larboard tack.

Of the Order of Retreat.

We ſhall here conſider the order of retreat only in a line at right-angles with the direction of of the wind, becauſe hence the order of battle is more eaſily attained. The intention of this order is to conduct a fleet of merchantmen from the enemy with ſafety. The merchantmen are to ſituate themſelves before the order of retreat, and not to extend without the line on either ſide.

Of the Lines of Bearing.

The line of direction which a fleet preſerves in either of the orders, is termed the line of bearing of the order. Thus the line of bearing of the order of battle is ſix points from the wind on either tack; the line of bearing of the order of retreat is acroſs the wind; and the line of bearing of the order of ſailing is the courſe ſteered.

Of Manœuvring in Succeſſion.

When a fleet of ſhips tack or perform any manœuvre, one after the other, in the wake of the next ahead, it is termed tacking or manœuvring in ſucceſſion.

PRO-

PROBLEM I.

To form the Order of Sailing in Three Lines, the Fleet being irregular.

To form this order with the leaſt confuſion, the ſhips leading the ſtarboard and larboard lines are to take their ſtations abreaſt of the van ſhip of the centre line, leading on under eaſy ſail; and the reſt of the ſhips are to ſearch out and follow their next ahead.

PROB. II.

From the Order of Sailing, with the Wind aft, to form the Order of Battle.

Let the ſmall circles in the three lines FG, HI, KL, plate 3, figure 1, repreſent a fleet in the order of ſailing, with the wind in the direction of the arrow; then D. B. is the ſtarboard line of bearing from the van ſhip of the ſtarboard line; and AC is the larboard line of bearing from the van ſhip of the larboard line.

If it be required to form the order of battle on the ſtarboard tack, the van ſhip of the ſtarboard line is to haul her wind on the ſtarboard tack, and ſail along the line of bearing D B, the

the reſt of her line following in ſucceſſion as they arrive in her wake, at the point K; and the centre and larboard lines are to haul in ſucceſſion a point to ſtarboard, and ſteer along the dotted lines HAFD, which will bring their vans at the points A and D in the line of bearing, at the ſame diſtance they held from each other in the order of ſailing. When the vans are arrived at the points A and D, their lines are to heave-to; the centre making ſail again when its van can join at a proper diſtance from the rear of the ſtarboard line, and the larboard line making ſail when its van can join at a proper diſtance from the rear of the centre line: thus when the rear ſhip of the larboard line has arrived at D, the whole fleet will be in the order of battle, as repreſented by the large dots in the line of bearing DB.

To form the order of battle on the larboard tack, the van ſhip of the larboard line is to haul her wind along the larboard line of bearing A.C. the reſt of the fleet following as before related.

PROB. III.

From the order of Sailing with a Side Wind, to form the Order of Battle on the ſame Tack.

Let the ſmall circles, plate 3, fig. 2, repreſent a fleet in the order of ſailing with the wind on the larboard ſide, in the direction of the arrow: then AC is the larboard line of bearing from the van ſhip of the lee-line.

The van ſhip of the lee-line being in the line of bearing, this line is to heave-to; the centre and weather-lines bearing up in ſucceſſion to a courſe as much off from the former courſe as half the angle ACD, formed by the line of the ſhips abreaſt, and the line of bearing; thus their vans will arrive at the points B and A in the line of bearing, at the ſame diſtance they held in the order of ſailing.

The centre line is to heave-to when its van arrives at the point B, and the weather-line is to haul the wind in ſucceſſion along the line of bearing, as the ſhips arrive at the point A. The other lines are to make ſail again and follow, as mentioned in the foregoing problem.

The van of the centre-line is in the line of bearing, when the van of the lee-line bears ſix points from the oppoſite point to the wind; and the van of the weather-line, when the van ſhips of the lee line are in the ſame direction.

To form the order upon the other tack, firſt form the order upon the ſame tack, then tack in ſucceſſion.

Note.—If the right-angle EDC be ſo divided by the line DA, that the angle EDA be equal to half ACD, the triangle ACD is iſoſceles, having the leg AC equal to DC.

PROB. IV.

From the Order of Sailing with the Wind aft, to form the Order of Retreat.

Let the ſmall circles in the three lines of plate 3, fig. 3, repreſent a fleet in the order of ſailing, the wind being aft, in the direction of the arrow. Then AC is the line of bearing of the order of retreat.

If it be required to form the order of retreat to ſtarboard, let the van ſhip of the ſtarboard-line haul along the line of bearing on the ſtarboard tack, keeping the wind abeam; the remainder of the lines following as related in problem 2. When all the fleet are in the line of bearing, they are to bear away together, and ſteer the intended courſe, as repreſented by the

the dotted parallel lines, regulating their ſails ſo as to continue in a line acroſs the wind.

PROB. V.

From the Order of Sailing with a Side Wind, to form the Order of Retreat.

Let the ſmall circles, plate 3, fig. 4, repreſent a fleet in the order of ſailing with a ſide wind, in the direction of the arrow. Then CA is the line of bearing of the order of retreat, from the van ſhip of the lee-line.

The van ſhip of the lee-line being in the line of bearing, this line is to heave-to, the centre and weather-lines bearing up in ſucceſſion to a courſe as much off from the former courſe as half the angle BCD, for the reaſon given in prob. 3. The centre line is to heave-to when its van arrives at the point B, the weather-line hauling its wind abeam at the point A, along the line of bearing CA, the lee-lines following in ſucceſſion, as related at the concluſion of problem 2. When all the ſhips are in the line of bearing, they are to bear away altogether to the intended courſe, as ſhewn by the parallel lines.

PROB. VI.

From the Order of Battle to form the Order of Sailing, on the same Tack, upon particular Bearings.

Let AC, plate 3, fig. 5, reprefent the order of battle upon the larboard tack; A1, B2, C3, the intended lines of the order of failing from the fhips A.B.C. which are to become the van fhips of the three lines.

Now, to form the order of failing, let the van fhips A.B.C. bear away, and fteer along their refpective lines of bearing, the reft of the fhips following in fucceffion. When the weather-line has formed, it is to heave-to; when the centre is abreaft of the weather, it alfo is to heave-to; and when the lee-line is abreaft of both, they are to make fail.

If the lines are now at an improper diftance, let them regulate accordingly.

PROB. VII.

From the Order of Battle, to form the Order of Retreat.

Let AB, plate 3, fig. 6, be the order of battle on the larboard tack, and BC the line of bearing of the order of retreat.

Now, to form the order of retreat, the rear ſhip B of the line of battle is to heave-to, and the reſt of the ſhips are to bear away, and ſteer with the wind one point upon the larboard quarter, till they ſucceſſively bring the ſhip B at right angles with the wind, when they are to heave-to. The ſhips being arrived in the order of retreat, they are to proceed upon the proper courſe, being careful to regulate their ſailing ſo as to preſerve themſelves in a line acroſs the wind.

Was the fleet in a line upon the ſtarboard tack, the rear ſhip is to heave to, and the reſt are to ſteer with the wind a point upon the ſtarboard quarter, till they bring the rear ſhip at right angles with the wind. By ſteering along with the wind a point quartering, the fleet ſails along the dotted parallels, and arrives in the order of retreat at the ſame diſtance each ſhip held from the other in the order of battle, for ABC is an iſoſceles triangle.

PROB. VIII.

From the Order of Retreat to form the Order of Sailing, with the Wind on the ſtarboard Side.

Let A.B.C. plate 3, fig. 7, repreſent the order of retreat, A1, B2, C3, the three lines of the

 order

order of ſailing from the ſhips ABC, which are to become the vans.

Now, to form the order of ſailing, let the van ſhips A.B.C. ſteer along their reſpective lines of bearings, the reſt of the fleet hauling the wind abeam, and following their van, as they ſucceſſively arrive in their wakes at the points A.B.C. When the weather-line C3 has formed, it is to heave-to, the centre doing the ſame when abreaſt of the weather-line; and when the lee-line is abreaſt of both, they are to make ſail. If the lines be now at an improper diſtance, they are to regulate accordingly.

To form the order with the wind on the larboard ſide, D is to become the van of the weather-line, and the ſhips are to haul the wind upon the larboard tack, following their reſpective vans.

PROB. IX.

From the Order of Retreat, to form the Order of Battle.

Let AD, plate 3, fig. 6, repreſent the ſhips in the order of retreat, and AB the larboard line of bearing of the order of battle.

Now, to form the order of battle on the larboard tack, the larboard ſhip A, which is to become

come the van of the order of battle, is to heave-to on the larboard tack, and the remainder of the ſhips are to ſteer with the wind a point upon the larboard quarter, till they bring the van to bear ſix points from the wind, when they are to heave-to on the larboard tack. Thus they will proceed along the dotted parallels, and arrive in the order of battle at the ſame diſtance from each other they held in the order of retreat, BAD being an iſoſceles triangle.

If it be required to form upon the ſtarboard tack, the ſhip D is to heave-to upon the ſtarboard tack, and the reſt are to ſteer with the wind a point upon the ſtarboard quarter, till D bears ſix points from the wind, when they are to heave-to on the ſtarboard tack.

PROB. X.

To work to Windward in the Order of Sailing.

Let the three lines, A1, B5, C9, plate 3, fig. 8, repreſent the lines of bearings of the order of ſailing when cloſe hauled upon the larboard tack, and the three lines 1C, 5D, 9E, the three lines of bearings, when cloſe hauled upon the ſtarboard tack, and the ſmall circles numbered 1, 4, 7, the van ſhips in the order of failing upon the larboard tack abreaft of each other.

To explain the manner of performing this problem, for the fake of fimplicity, we fhall confider the manœuvres of the three van fhips cnly, which is fufficient, as the remainder of the fhips are to tack in fucceffion after their refpective van.

Now, to form the order of failing on the other tack, let the van fhip 1 of the lee-line tack and ftand on; and when the van fhip 4 of the centre line brings the van of the lee-line four points abaft her lee-beam, viz. in the direction 5.2. fhe is to tack; the van of the weather line tacking when the van of the centre is four points abaft her lee-beam, viz. in the direction 9.6. at which time the fhips will be abreaft of each other upon the ftarboard tack, as reprefented by the large dots 3. 6. 9.

PROB. XI.

To work to Windward in the Order of Battle.

To work to windward in the order of battle, the van fhip is to tack firft, and the reft are to tack in fucceffion in the wake of the next a-head.

PROB. XII.

To restore the Order of Battle, should the Wind come forward less than six Points.

Let AB, plate 3, fig. 9, be the order of battle before the wind shifts, BC the line of bearing of the order of battle from the rear ship after the wind has shifted.

Now, that the ships may form in the line of bearing BC, let the rear ship B heave-to, and the rest box off, and bear up as many points from the line AB *as half the difference between* 16 *and the number of points the wind has altered, added to what it has altered*, till each ship, from rear to van, shall successively bring the rear ship to bear six points from the point opposite to the wind, when they are to heave-to, till the line be formed as they are in the line of bearing.

Demonstration of the foregoing Rule for bearing up.

That the ships in the line of battle AB may form, at their respective distances, in the line of bearing BC, it is necessary that the course of each ship shall be parallel to the base of the isosceles triangle ABC. Therefore, each must bear

bear up equal to the angle DAC, which is equal to CAB plus CBA. Now, ABC is equal to what the wind has ſhifted; and as all the angles together of the iſoſceles triangle ABC are 16 points, the angles at the baſe muſt each be half the difference between the angle B and 16.

PROB. XIII.

To reſtore the Order of Battle, ſhould the Wind draw aft leſs than ſix Points.

Let AB, plate 3, fig 10, be the order of battle before the wind changes; AC the line of bearing of the order of battle after the wind has changed. Now, that the ſhips may form in the line of bearing AC, the van ſhip is to heave-to, and the reſt are to bear up equal to angle ABC, which is half the difference between 16 points and what the wind has changed: thus they will proceed along the dotted parallel lines; and as each ſhip, ſucceſſively from van to rear, ſhall bring the van ſhips to bear ſix points from the wind, ſhe is to heave to, as then ſhe is in the line of bearing.

To regulate the Diſtances of the Ships.

As it is impoſſible to regulate the diſtances of ſhips from each other by gueſs, would it not be better

better, as the mafts of fhips of the line are not very diffimilar in height, to regulate it by keeping the main-top-gallant truck of the fhip next ahead, at a particular altitude above her water-line, which may be readily done by a quadrant, and would fubftitute fomewhat of truth in the lieu of guefs. For the fake of example, let it be prefumed, that from the truck to the water-line is 168 feet, then for the fhip ahead to be half a cable off, her truck and water-line muft fubtend an angle of about 25 degrees, at a cable off about 13 degrees, and at two cables off about 6 degrees.

The diftance of the lines from each other fhould be half their length, which will give fufficient room for manœuvring. They will be at this diftance from each other, if the rear of the centre be in ftation, when the rear of the centre-line, obferved from the van fhips of the ftarboard and larboard lines, fubtends an angle of 26 degrees with their wakes.

CHAP. XIV.

ON SIGNALS.

ALL ſignals, to be effectual, muſt be ſimple, and compoſed in ſuch a manner as to expreſs the ſame ſignification at whatever maſt-head, or yard-arm, they may be diſplayed from. The following day ſignals will be found to have theſe advantages.

The plan is, to expreſs *numbers* by diſtinctly coloured flags, each number referring to *a certain ſignification*, to be agreed on before-hand.

Mode of expreſſing 999 Numbers by Eleven Flags and One Pennant.

In the table of flags, plate 3, there are ten flags, each flag repreſenting the *number* placed againſt it, and a ſubſtitute flag repreſenting the *ſame number* with any flag which may have been hoiſted next above it. To expreſs from 9 to 99, hoiſt the flag ſtanding for the firſt figure of the given number, above the flag ſtanding for the ſecond; that is, to expreſs 45, hoiſt flag 4, above flag 5, as ſhewn plate 3, figure 11;—but ſhould the

the given number be two ſimilar figures, for inſtance 55, it is to be expreſſed by hoiſting flag 5, above the ſubſtitute, as ſhewn, plate 3, figure 12. To expreſs from 99 to 999, hoiſt the flags one above the other in the order of the figures of the given number;—thus, 245 is expreſſed by hoiſting flag 2, above 4, above 5; and 225 by flag 2, above the ſubſtitute, above 5; and 522, by flag 5, above 2, above the ſubſtitute. But as there are ſome inſtances in which the eleven flags are inſufficient to expreſs numbers above 99, a ſhort thick pennant, denoting that *the laſt figure of the given number is the ſame as the firſt*, is propoſed to remedy the defect; therefore, to expreſs 545, which is a number that could not be expreſſed by the eleven flags, hoiſt flag 5, above 4, above the pennant; alſo to expreſs 444, hoiſt flag 4, above the ſubſtitute, above the pennant.

Should it not be required to expreſs more than 199 ſignals, it will be found more ſimple to let the pennant expreſs 100.

Each flag is to be marked on the tabling with the *number* it repreſents, (which will identify the flag) and is to be fitted with a tack about a fathom long, ſo that when one flag is bent to the tack of another, they may appear *diſtinct*, at a diſtance, when they are diſplayed.

As

As flag ſignals are frequently rendered indiſtinct, either from poſition, want of wind, or a dull light, the author preſumes that day ſignals *compoſed of cones and cylinders* would be the moſt perfect kind hitherto invented, ſince they neither require wind, nor a very diſtinct light, and have *the ſame appearance from every horizontal poſition.* By means of the eleven ſhapes contained in the table of ſhapes, plate 3, ——— 999 numbers may be expreſſed. Theſe ſhapes repreſent the ſame ſignification with their correſponding flags, and the one, figure 14, performs the office of the pennant; therefore the numbers are expreſſed by them in the ſame manner as by the flags.

Theſe ſhapes may be made of light wicker, and painted black; and if about three feet diameter, they will appear diſtinct to a conſiderable diſtance. I have often obſerved a top-gallant-truck, an object not more than a foot over, when the *colour* of the flag hoiſted to it was perfectly *indiſtinct.*

Should the room theſe ſhapes occupy, when made of wicker, render them objectionable, they may be formed of canvas, ſet out with hoops; thus made, they will collapſe into a ſmall compaſs when they are out of uſe.

The ſhapes will ſhew to greater advantage if they be hoiſted to the yard-arms, or ſtays, as re-

pre-

presented by figure 13, plate 3, instead of the mast-heads.

In blowing weather, or when, from circumstances, ships cannot approach near enough to each other to hail, it will be found convenient to have a light board, about eight feet by three, painted *black*, that the latitude, longitude, and any short sentences may be communicated by writing upon the board with chalk. Upon shewing the board, wave a small white flag to the ship you wish to communicate with, which is to be repeated by her when the writing is understood.

A telegraph will also be found extremely convenient to express the numerical signals, and may be formed in the following manner. Fig. 15, plate 3, represents a large board, contrived to turn round upon the pole AC:——BD, BD are grooves to receive the figures of the number to be shewn, as represented by 453, each figure being painted black upon a thin white board or sheet of tin. Let the other side of the board be prepared with grooves in the same manner, for the convenience of fixing another number while the first is exhibiting. Between each exhibition, wave a white flag, to denote that the number is understood.

By the addition of an alphabet to this telegraph, *words* may be expressed to distant parties: for

for inſtance, let each party have *a dictionary* with the words numbered, under each letter of the alphabet, from one throughout; then to expreſs any word, ſhew its number and the letter it begins with, as repreſented in the figure by A 453.

To communicate a ſentence expeditiouſly, let it be written as ſhort as poſſible, leaving out ſuch words as can be omitted without deſtroying the idea, and above each word write the number placed againſt it in the dictionary: a ſentence thus prepared, and placed before the perſon who attends the telegraph, will very much facilitate the communication.

Significations.

The ſhips of the fleet are to be denoted by particular vanes, fixed at either of the maſt-heads. Each ſhip is alſo to have aſſigned to her a particular pennant, which, being hoiſted alone, expreſſes a wiſh to communicate with that ſhip; but when hoiſted with a ſignal, expreſſes that the ſignal particularly applies to her.

General Significations.

0 An acknowledgment that the ſignal is underſtood by the fleet.
1 Annulling.
2 Tack, headmoſt and weathermoſt firſt.
3 Veer, ſternmoſt and leewardmoſt firſt.
4 Make ſail.
5 Shorten ſail.
6 Ships ahead, ſhorten ſail.
7 Ships aſtern, make more ſail.
8 Gather together.
9 Open to a greater diſtance.
10 Heave-to on the ſtarboard tack.
11 Heave-to on the larboard tack.
12 Take in your ſtudding-ſails, and prepare to haul the wind.
13 Haul the wind to ſtarboard.
14 Haul the wind to port.
15 Ships to ſtarboard, join the fleet.
16 Ships to port, join the fleet.
17 Continue as before, though the commodore does otherwiſe.
18 Prepare to hoiſt foreign colours, (I will ſhew the nation's jack I mean.)
19 Shew no lights during the night, and keep in cloſe order, as I ſhall carry no top-light.

20 A ſtrange ſail is ſuſpected to be in the fleet, any ſhip diſcovering her, is to hoiſt her enſign and run towards her.

21 Diſperſe, and each ſhip do the beſt for herſelf.

22 Be particularly attentive, as I am going to make ſeveral ſignals which I intend to have executed in the night.

23 Obſerve my telegraph.

24 For all commanders, or a particular commander.

25 For an officer from every ſhip, or a particular ſhip.

26 Open your ſignal letter.

To prevent theſe ſignals being of ſervice to the enemy, let each ſhip be furniſhed with a ſignal letter, expreſſing, that "hereafter the numbers annexed to the ſignifications will be ſhifted." For inſtance, let the ſignifications in future be numbered 1, 2, 3, &c. inſtead of 0, 1, 2, &c. &c. &c.

Hours after Dark.

27	At the hour of	6	before midnight.
28	Ditto -	7	
29	Ditto -	8	
30	Ditto -	9	
31	Ditto -	10	
32	Ditto -	11	
33	Ditto -	12	midnight.
34	Ditto -	1	after midnight.
35	Ditto -	2	
36	Ditto -	3	
37	Ditto -	4	
38	Ditto -	5	
39	Ditto -	6	

The purpofe of thefe fignals will be feen by the two following examples. Let it be prefumed that the fleet fhould be chafed during the day, and that it is the intention of the commodore to avoid the enemy by altering the courfe after dark. To make a fignal during the night for this purpofe would fhew his fituation; therefore, before dark, let the commodore fhew the hour he intends to alter his courfe, and the courfe he means to fteer. Or fhould the commodore imagine he has not fufficient run for the night, let him fhew the hour he intends to heave-to, which will prevent confiderable confufion, as

 each

each ſhip will be prepared for the circumſtance, and upon the look-out to avoid thoſe which have already hove-to.

Points of the Compaſs.

40	North	48	Eaſt	56	South	64	Weſt
41	N b E	49	E b S	57	S b W	65	W b N
42	NNE	50	ESE	58	SSW	66	WNW
43	NE b N	51	SE b E	59	SW b S	67	NW b W
44	NE	52	SE	60	SW	68	NW
45	NE b E	53	SE b S	61	SW b W	69	NW b N
46	ENE	54	SSE	62	WSW	70	NNW
47	E b N	55	S b E	63	W b S	71	N b W

Theſe ſignals are to ſhew the courſe to be ſteered; or the bearings of an object pointed out by ſignal.

Significations which may be expreſſed by Ships of the Fleet.

72 A ſtrange ſail.
73 Two ſtrange ſail.
74 Three ſtrange ſail.
75 A fleet.
76 Requeſt the aſſiſtance of a ſurgeon; ſhip neareſt, to ſend her ſurgeon.
77 Requeſt the commodore to go ahead, to ſet up my rigging.
78 Requeſt to ſpeak the commodore.
79 We are over-preſſed with ſail.
80 We have ſprung a leak.

81 A

81 A mutiny is on board us.
82 We ſee the land.
83 We have got ſoundings.
84 We require immediate aſſiſtance.
&c. &c.

Significations addreſſed to particular Ships.

85 Come within hail.
86 I intend to ſend a boat on board you.
87 Send a boat.
88 Lead the fleet.
89 Take a particular ſhip in tow. (The tower and tow's pennants will be ſhewn.)
90 Caſt off the ſhip in tow.
91 Make ſail upon particular bearings, (as will be ſhewn by the bearings expreſſed) and look out for the land.
92 Make ſail upon particular bearings, and ſound.
93 Chaſe upon particular bearings.
94 Bring the ſtranger to the commodore.
95 Examine the ſtranger. If neutral, paſs her.
96 Hoiſt the admiralty ſignal.
97 Return to the fleet.
98 Situate yourſelf between the diſtant ſhips and the fleet, to repeat ſignals.
99 Keep your ſtation.
&c. &c.

Queſtion-Significations.

100 Do you ſee the land?
101 Have you got ſoundings?
102 Do you gain upon the chaſe?
103 Is the chaſe a friend, enemy, or neutral?
104 Is ſhe of force?
105 What was your longitude by the mean of your late obſervations, continued on, by the chronometer, to the preceding noon?
106 What was your longitude by the chronometer, at the preceding noon?
107 What was your latitude by meridian, or double altitude, at the preceding noon?
108 What is your variation?
109 What are your ſoundings?
110 How many ſtrange ſail do you count?
&c. &c.

All theſe queſtions are to be anſwered as explained under the head, "*Anſwering-Significations.*"

Anſwering-Significations.

111 No.
112 Yes.
113 Friend.
114 Neutral.
115 Enemy.
116 Suſpicious.

117 I cannot ſay.

118 Inability.

119 Your ſignal is not diſtinct.

&c. &c.

N. B. Longitude, latitude, and variation, are to be anſwered by firſt hoiſting the flags expreſſing the number of the degrees, which being underſtood, then hoiſt the flags expreſſing the number of minutes; and if the number of ſail you count, or your ſoundings be required, anſwer by hoiſting the flags expreſſing the number of ſail, or the number of fathoms. Whenever the flags are intended to expreſs a number, hoiſt a ſhort white pennant with them to prevent their being taken for a ſignification.

Significations reſpecting Anchoring, and ſuch as will apply only when at Anchor.

120 Repair on board, every perſon belonging to the fleet.

121 Prepare to ſail.

122 Unmoor.

123 Moor.

124 Lie at ſingle anchor.

125 I ſhall get under way in the night. (The hour will be ſhewn.)

126 Weigh, outermoſt and leewardmoſt ſhips firſt.

127 Prepare to anchor.

128 Anchor.

129 Cut, or ſlip, outermoſt and leewardmoſt firſt. &c. &c.

Regular Manœuvring-Significations.

130 Form the order of ſailing.

131 Form the order of battle upon the ſtarboard-tack.

132 Form the order of battle upon the larboard-tack.

133 Form the order of retreat.

134 Starboard-line, heave-to.

135 Centre-line, heave-to.

136 Larboard-line, heave-to.

137 Starboard-line, make ſail, and follow in ſucceſſion.

138 Centre-line, make ſail, and follow in ſucceſſion.

139 Larboard-line, make ſail, and follow in ſucceſſion.

140 Tack altogether.

141 Tack in ſucceſſion.

142 Tack, and continue in the order of ſailing.

143 Rear ſhip, heave-to; the reſt form in the order of retreat.

144 Starboard ſhip, heave-to; the reſt form the order of battle, on the ſtarboard-tack.

145 Larboard ſhip, heave-to; the reſt form the order of battle, on the larboard tack.
146 Rear ſhip, heave-to; the reſt form again in the order of battle, upon the ſame tack.
147 Van ſhip, heave-to; the reſt form again in the order of battle, upon the ſame tack.
&c. &c.

N. B. Theſe ſignifications are adapted to the manœuvres explained in the Chapter "*On manœuvring a Fleet.*"

The commander of the fleet will fire a gun at the inſtant any of theſe manœuvres are to be executed.

Significations appertaining to Battle.

148 Keep the people to their quarters.
149 Exerciſe the great guns, and ſmall arms.
150 Van diviſion, engage.
151 Centre diviſion, engage.
152 Rear diviſion, engage.
153 Engage generally.
154 Leave off engaging.
155 Aſſiſt a diſabled ſhip.
&c. &c.

Night-Signals.

Night-ſignals ſhould be uſed as little as poſſible, ſince they are frequently miſunderſtood. Of neceſſity, they muſt be compoſed either of *ſound or light*, or the two blended together. If ſeveral lights are ſhewn together, that they may have the ſame appearance from every horizontal ſituation, it will be neceſſary to hoiſt them in a vertical poſition. In the following ſignals, this circumſtance is attended to: the plan is, to expreſs *numbers by different kinds of lights*; guns being fired merely to call the attention of the fleet, prior to making any ſignal.

To expreſs numbers, let each light repreſent *one*, each rocket *five*, and each blue-light *ten*, as ſhewn in the following table.

Numbers.	Lights.	Rockets.	Blue-lights.	Significations.
1	1			A general acknowledgment that the signal made is underſtood.
2	2			Tack, headmoſt and weathermoſt firſt.
3	3			Veer, ſternmoſt and leewardmoſt firſt.
4	4			Heave-to upon the ſtarboard tack.
5		1		Heave-to upon the larboard tack.
6	1	1		Annul the preceding ſignal.
7	2	1		Make ſail.
8	3	1		I am overpreſſed with ſail.
9	4	1		Shorten ſail.
10			1	To ſhew my ſituation.
11	1		1	Headmoſt ſhips ſhorten ſail.
12	2		1	Requeſt to ſpeak the commodore.
13	3		1	The fleet continue their courſe, though the commodore does otherwiſe.
14	4		1	I am in diſtreſs.
15		1	1	On diſcovering danger.
16	1	1	1	A ſtranger is ſuſpected to be in the fleet.
17	2	1	1	Haul two points to ſtarboard.
18	3	1	1	Haul two points to port.
19	4	1	1	North.
20			2	N. E.
21	1		2	Eaſt.
22	2		2	S. E.
23	3		2	South.
24	4		2	S.W.
25		1	2	Weſt.
26	1	1	2	N.W. &c. &c.

Instructions and Remarks.

While the commodore is laying to, it will be proper for him to carry a light at the bow-sprit end; also, upon any ship's thwarting, to save a man, or other circumstance, let her shew one light forward and two aft, that other ships may see her situation, and know the position of her head.

Upon the signal being made to tack or veer, let every ship, as she gets upon the other tack, carry a light for a short time at each cat-head, to shew that she is about.

In dark, disagreeable weather, the commodore should frequently make the signal "*To shew his situation*," and should avoid manœuvring during the night as much as possible.

Whenever a signal is made by the commodore, the top light should be covered, to prevent a confusion of lights.

All signal-lanthorns should be made of glass, and be big enough to hold several candles, for the sake of a brilliant light.

To discover whether a ship is of the fleet or not, shew *three* horizontal lights to her, and let the answer be *two* horizontal lights; or, let a *sign* and *counter-sign* be agreed upon—as, hail the suspected

ſuſpected veſſel with the words, *Lord Howe*, and let the anſwer be, *The firſt of June*.

Fog-Signals.

Fog-ſignals can only be compoſed of *ſound*, at different intervals, as ſhewn in the following table of ſignifications.

Significations.

1 gun, at intervals—To ſhew my ſituation.
2 guns, quick—Stand upon the ſtarboard tack.
3 guns, quick—Stand upon the larboard tack.
2 guns, a minute ſeparate—Lay-to on the ſtarboard tack.
3 guns, a minute ſeparate—Lay-to on the larboard tack.
2 guns, 2 minutes ſeparate—Make ſail.
3 guns, 2 minutes ſeparate—Shorten ſail.
4 guns, quick—Require aſſiſtance.
5 guns, quick—Diſcovering danger.

Inſtructions.

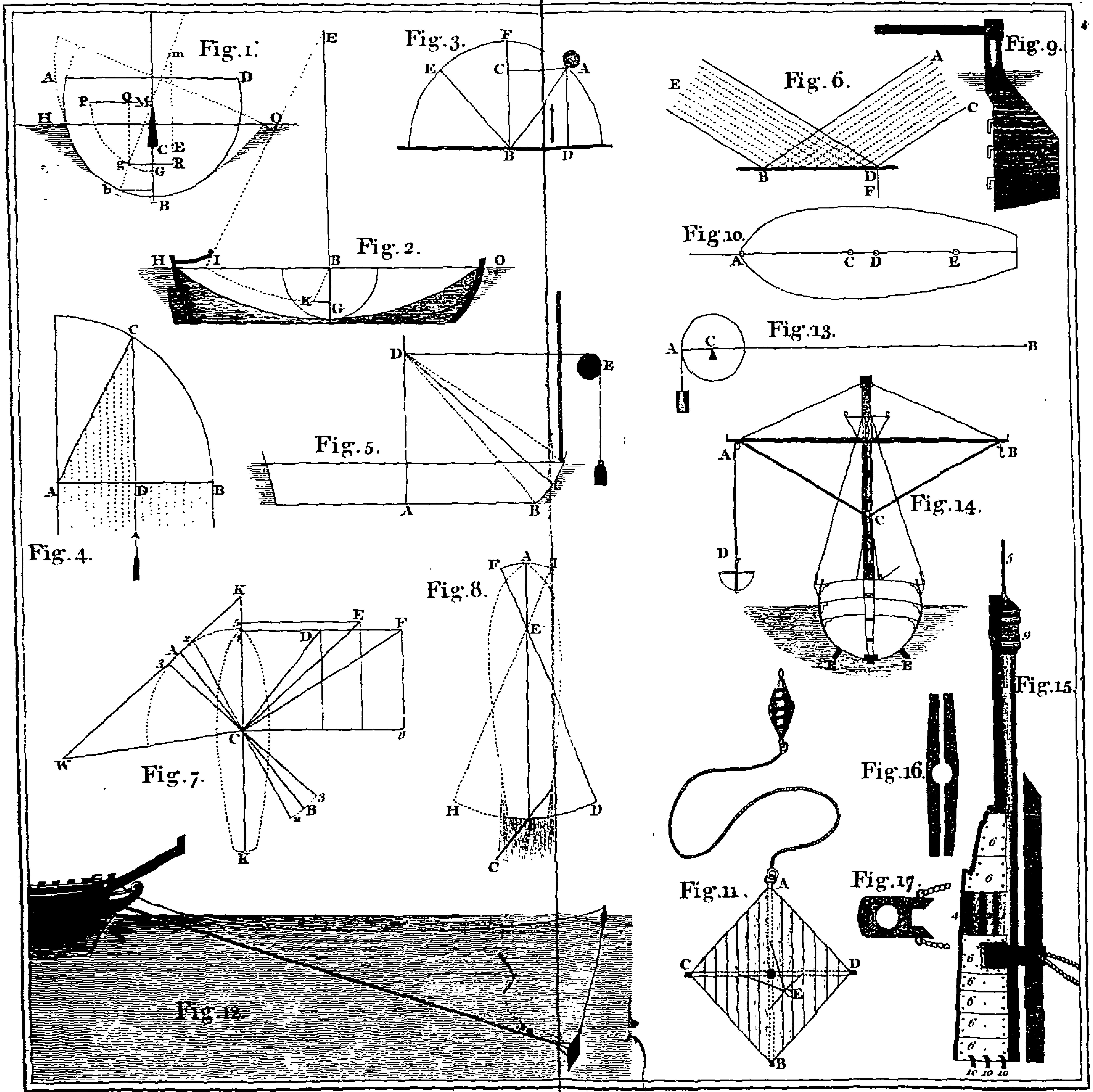
All ſhips upon their proper tack and courſe are to beat drums and ring bells at intervals.

All ſhips, either upon the wrong tack, or off their courſe, or laying-to, are to fire muſkets continually till they renew their courſe.

A general acknowledgment that the ſignal made is underſtood is avoided, as guns from different ſhips of the fleet would cauſe confuſion.

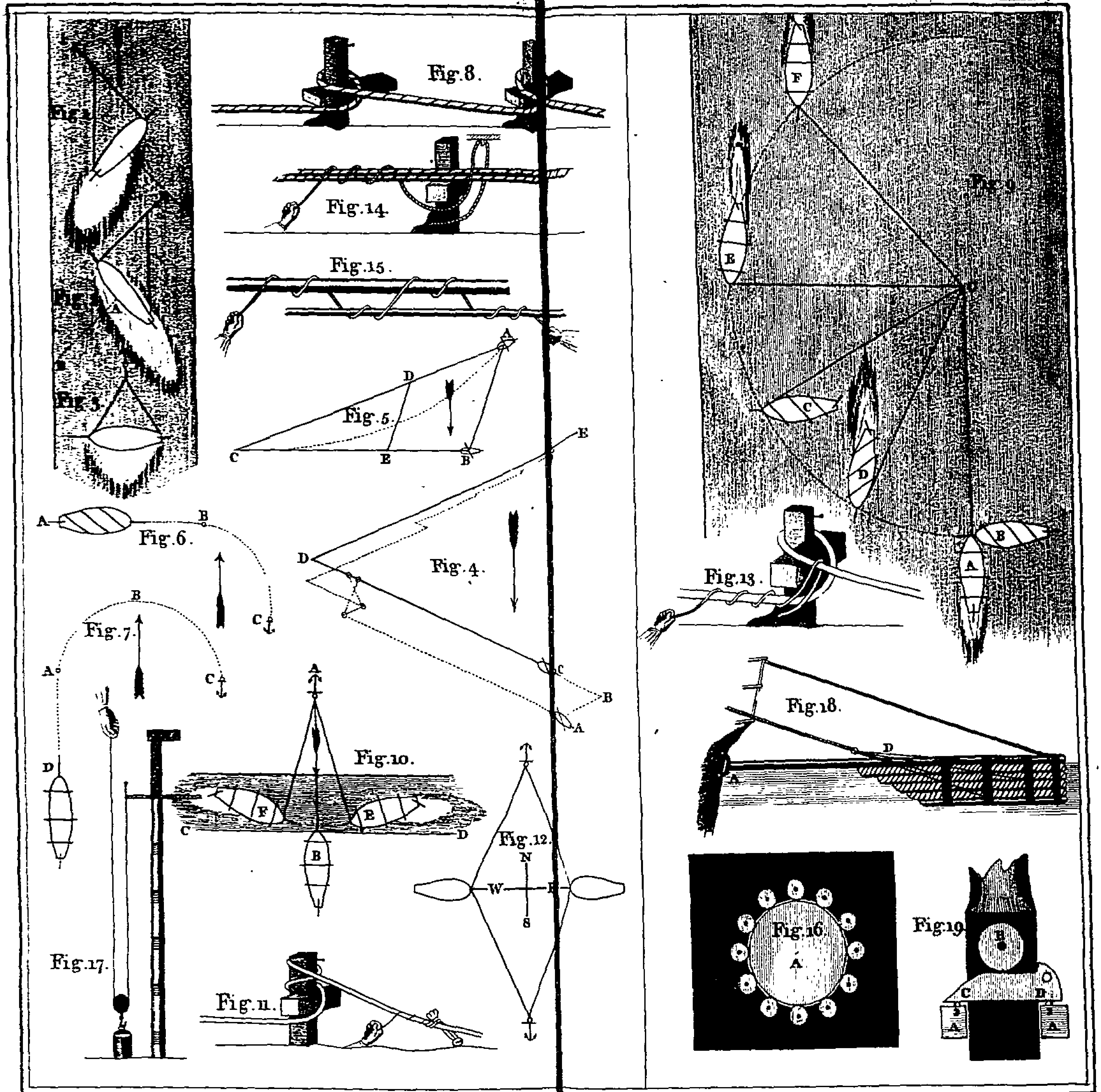
FINIS.

PLATE I.



Published as the Act directs, Aug. 13. 1793.

Jno. Lodge sculp.



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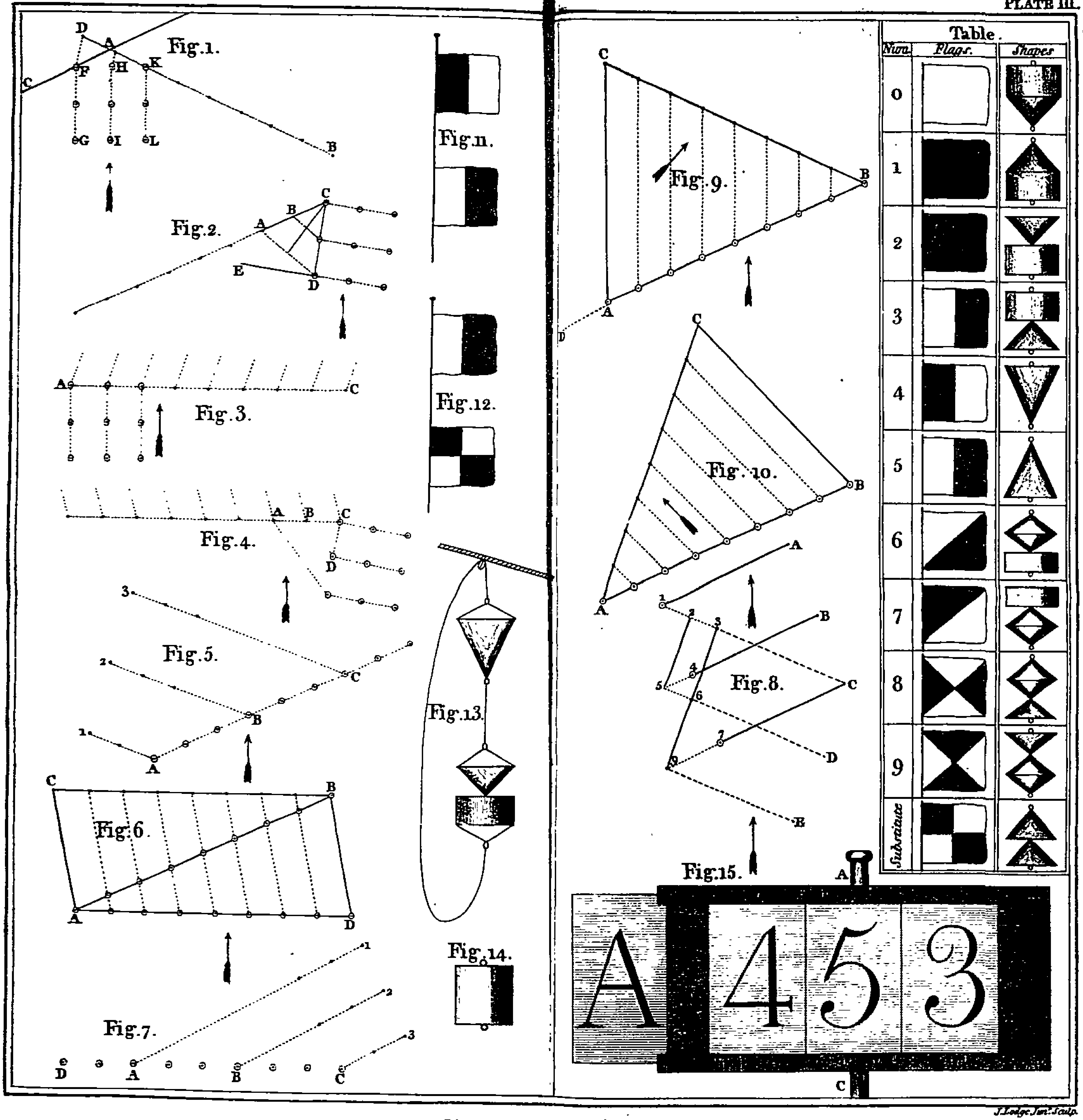

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